

Academie toegepaste biowetenschappen en chemie

Life science



2. Van gen naar eiwit

Agenda

Hoofdstuk	Onderwerp	Planning
21	Viruses	Week 1
15	From Gene to Protein	Week 2
16	Regulation of Gene Expression	Week 3
18	How evolution works	Week 4
19	Microevolution	Week 5
19	Species and speciation	Week 6
18	Uitloop	Week 7

Week 2

Transcriptie

Translatie

Verschillen tussen pro- en eukaryoten

Overzicht

[15.1 The Genetic Code](#)

[15.2 Prokaryotic Transcription](#)

[15.3 Eukaryotic Transcription](#)

[15.4 RNA Processing in Eukaryotes](#)

[15.5 Ribosomes and Protein Synthesis](#)

Van Gen naar RNA naar Eiwit

Het centrale dogma van de biologie

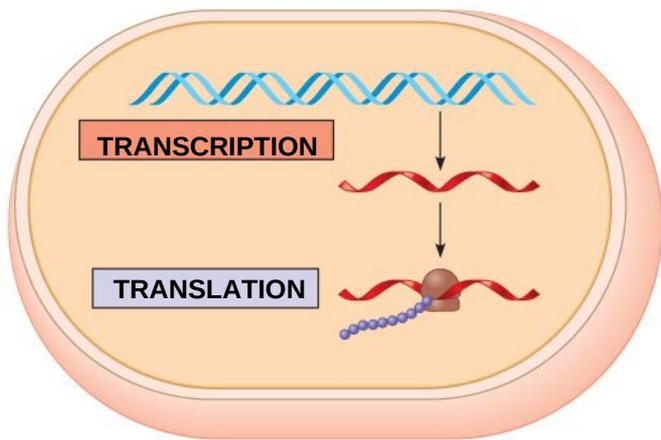
Vraag

Wat is gen-expressie?

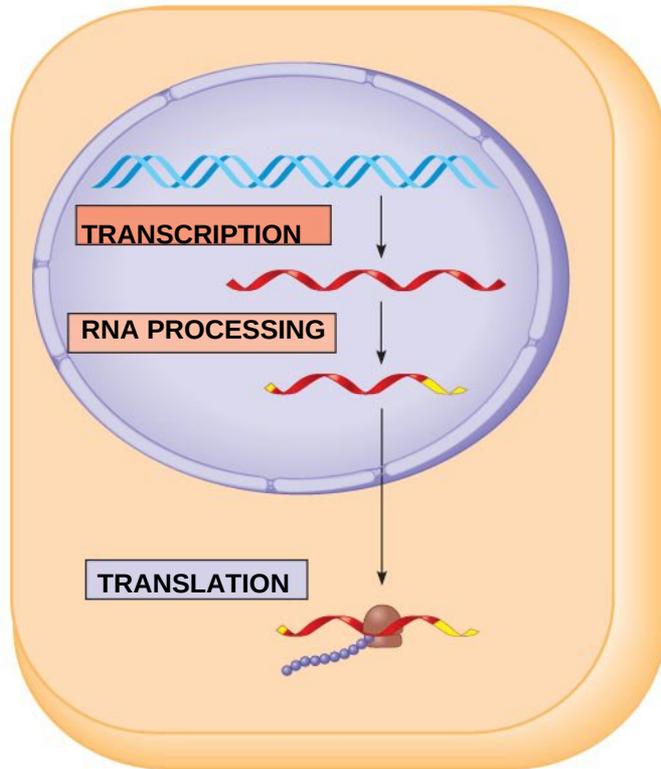
Vraag

Waarin verschillen prokaryoten en eukaryoten met betrekking tot gen-expressie?

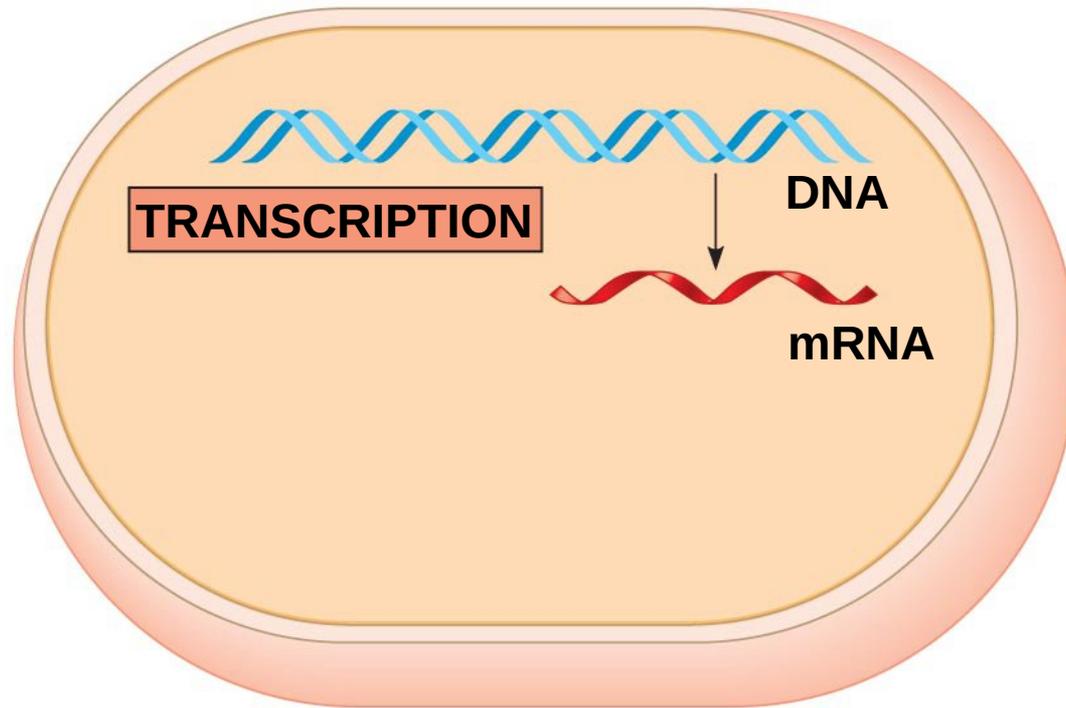
Fig. 17-3



(a) Bacterial cell

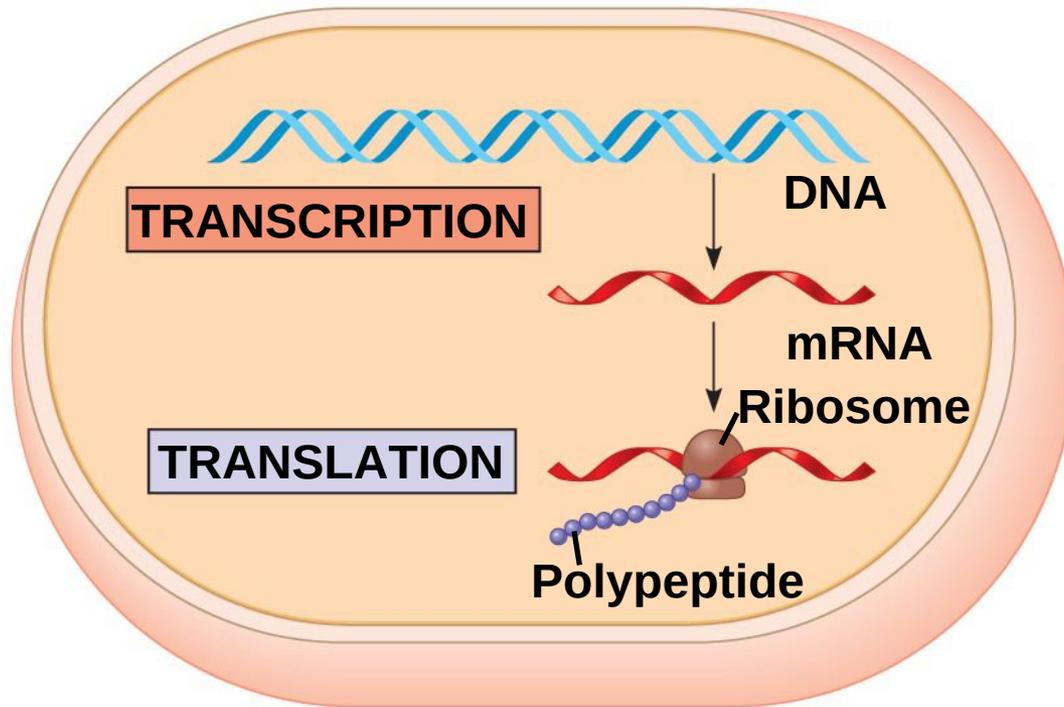


(b) Eukaryotic cell



(a) Bacterial cell

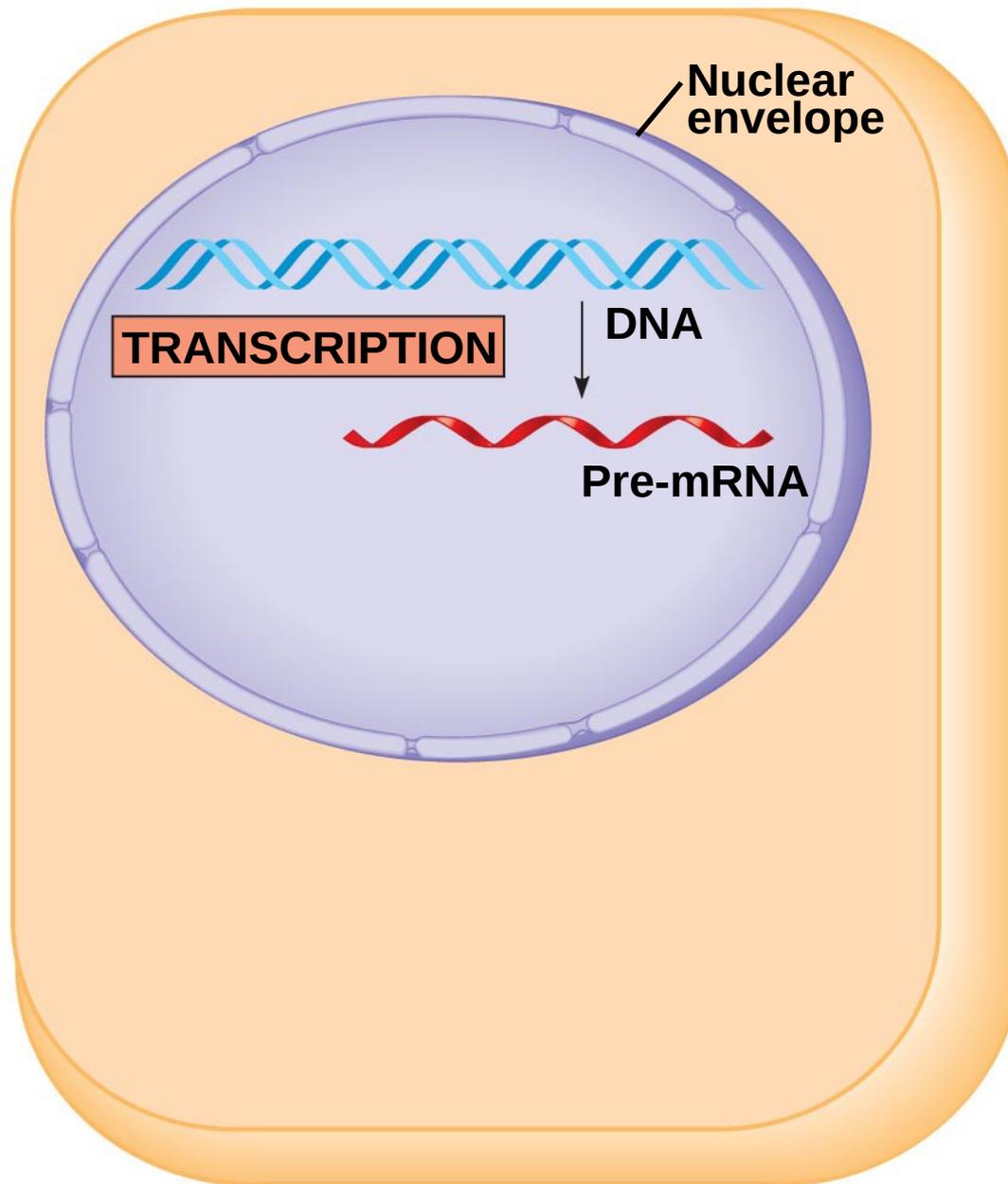
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(a) Bacterial cell

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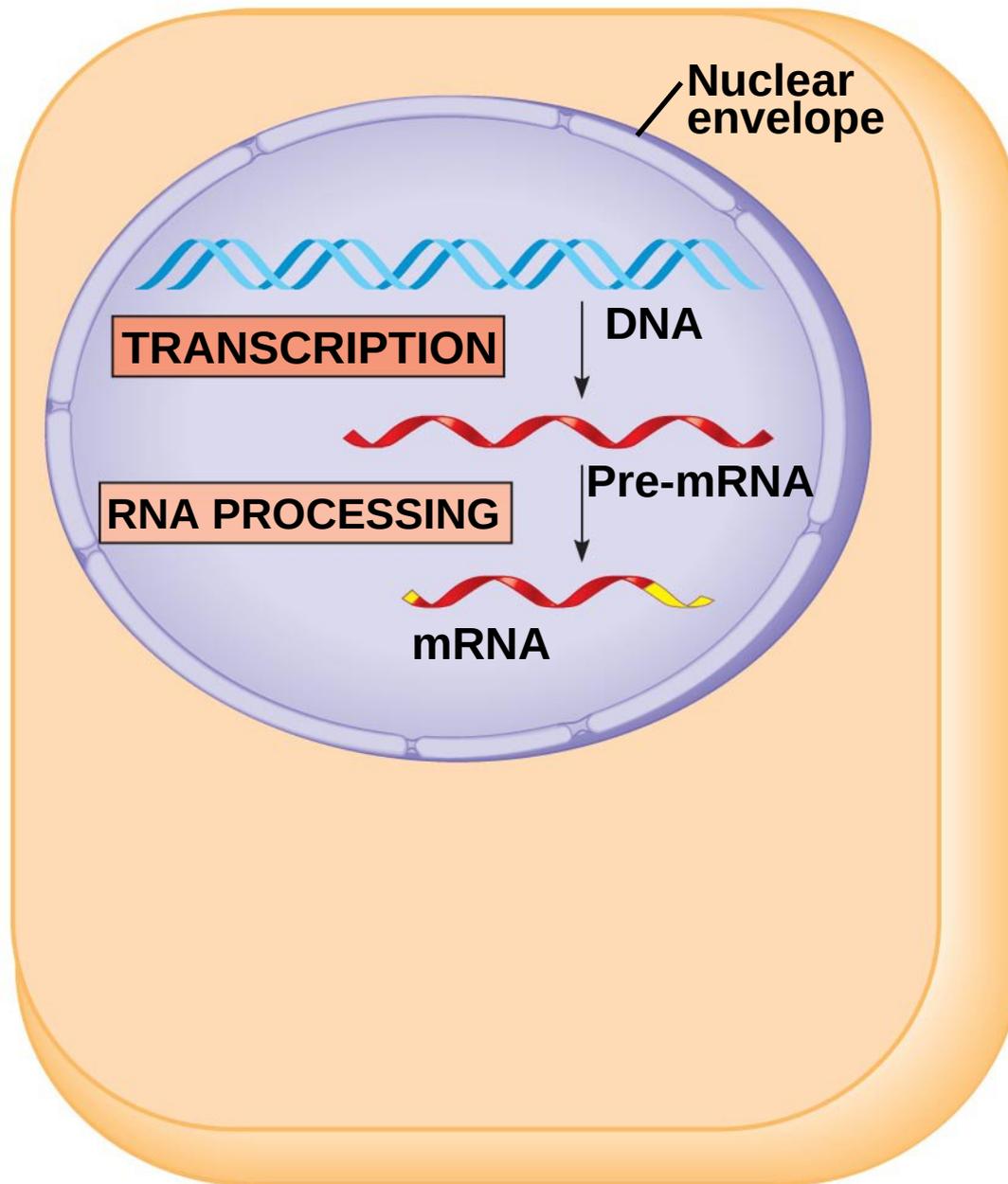
Fig. 17-3b-1



(b) Eukaryotic cell

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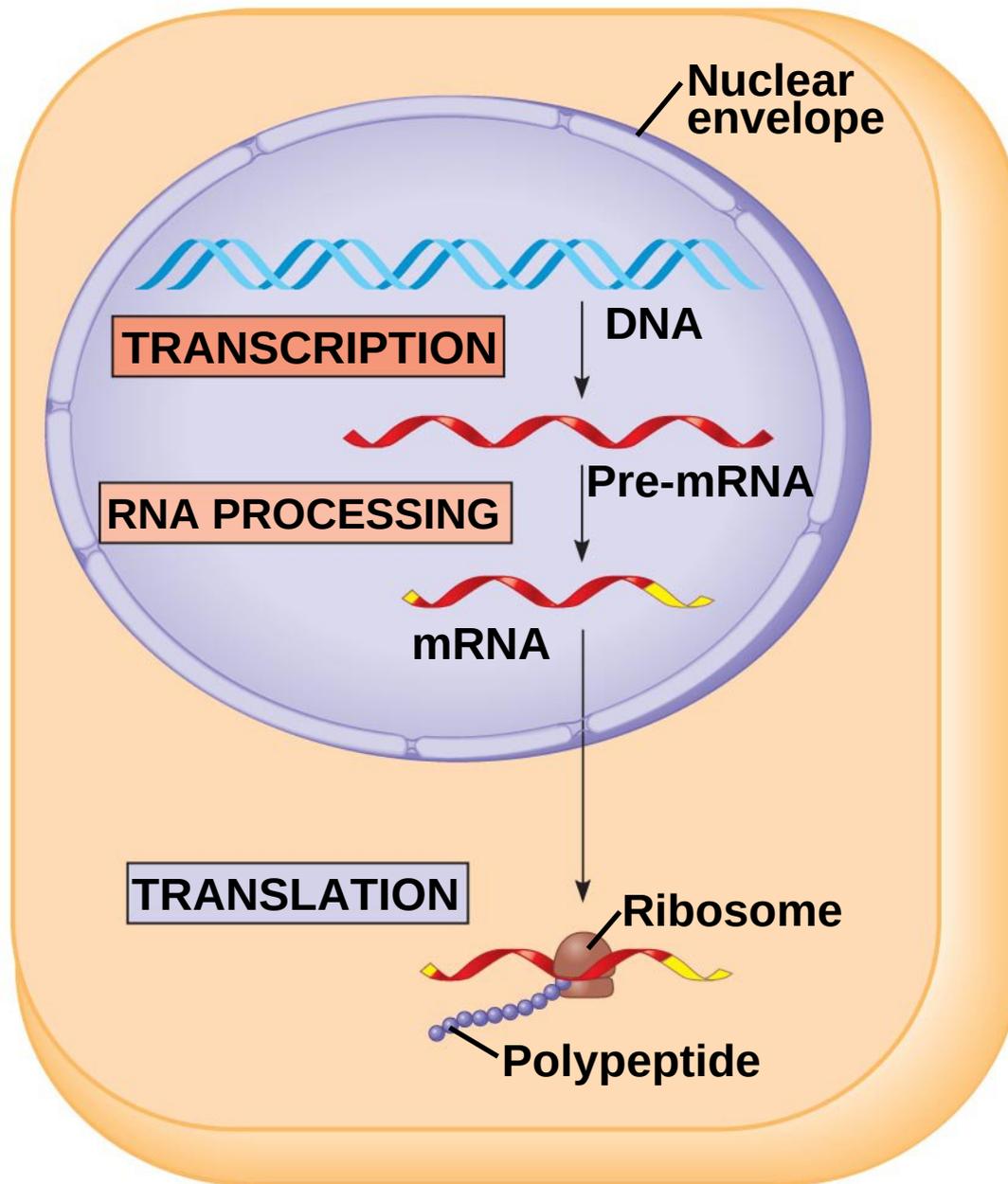
Fig. 17-3b-2



(b) Eukaryotic cell

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Fig. 17-3b-3



(b) Eukaryotic cell

Vraag

Uit hoeveel basen bestaat een codon?

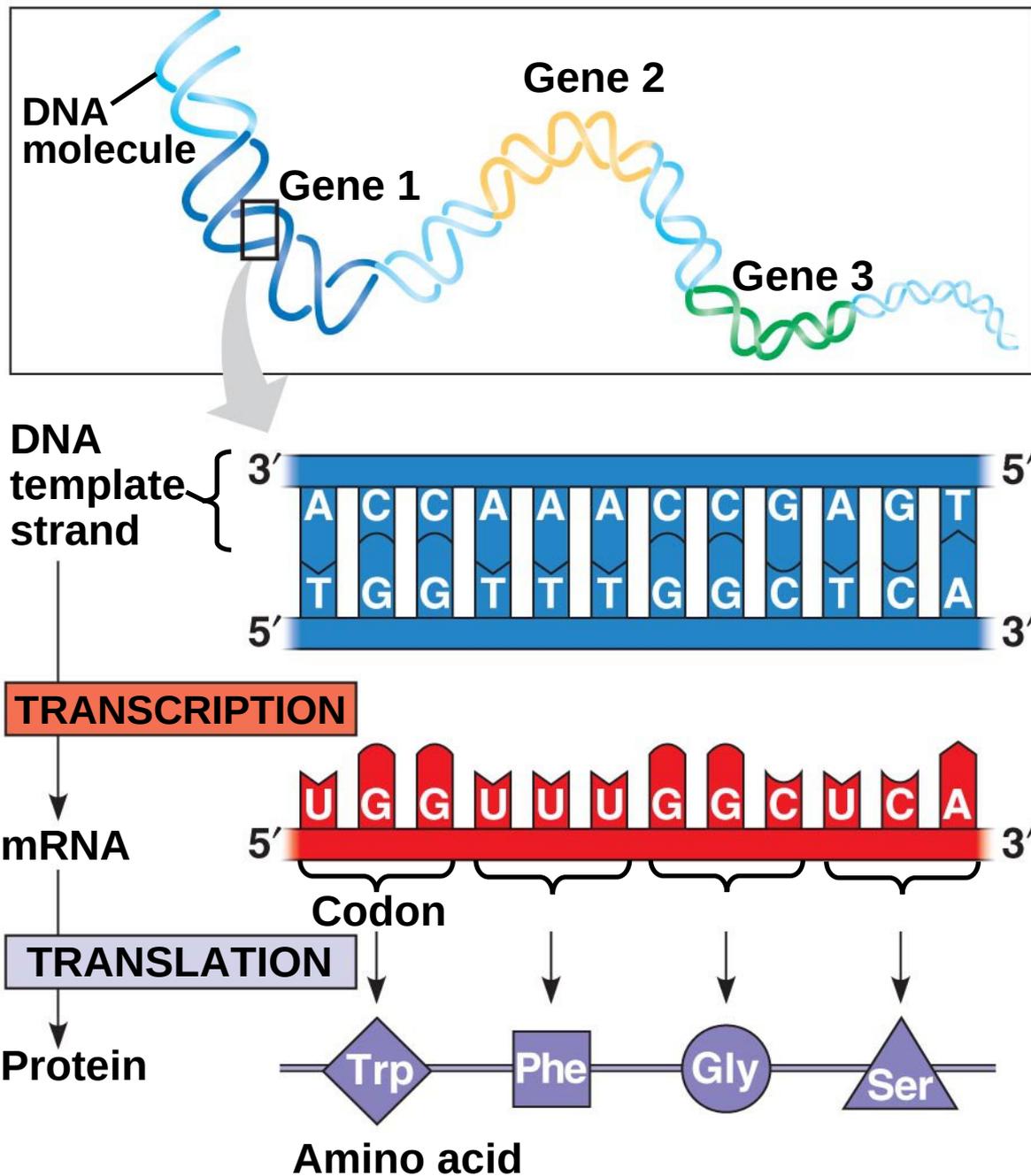
Hoeveel verschillende mogelijkheden geeft dat?

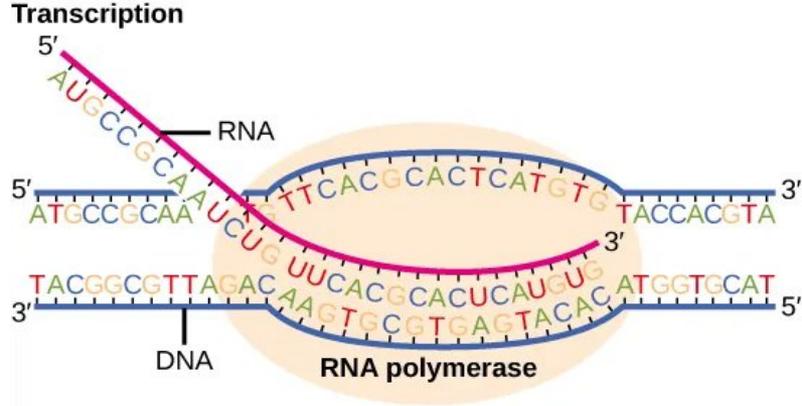
Hoeveel aminozuren zijn er?

Er zijn twee DNA strands, welke zal gelezen worden voor transcriptie?

Waar begint een gen?

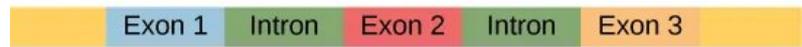
Fig. 17-4



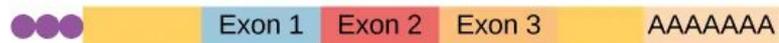


RNA processing

Primary RNA transcript



Spliced RNA



Translation

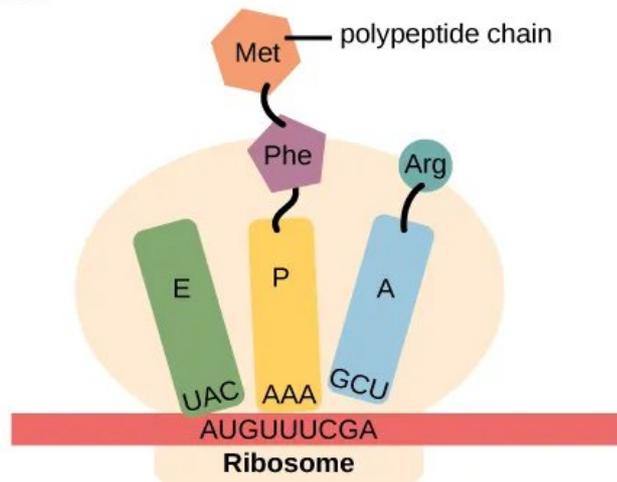


Fig. 17-5

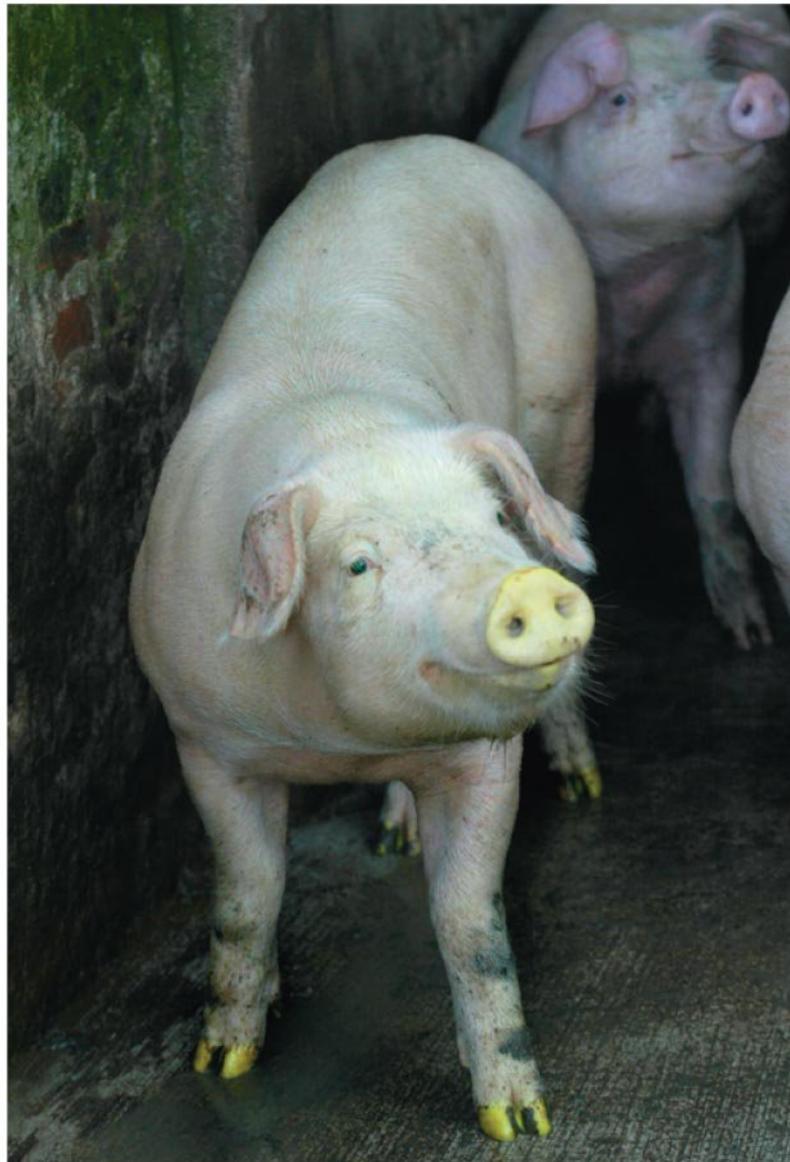
		Second mRNA base						
		U	C	A	G			
First mRNA base (5' end of codon)	U	UUU	UCU	UAU	UGU	U	Third mRNA base (3' end of codon)	
		UUC	UCC	UAC	UGC			C
		UUA	UCA	UAA Stop	UGA Stop			A
		UUG	UCG	UAG Stop	UGG Trp			G
	C	CUU	CCU	CAU	CGU	U		
		CUC	CCC	CAC	CGC	C		
		CUA	CCA	CAA	CGA	A		
		CUG	CCG	CAG	CGG	G		
	A	AUU	ACU	AAU	AGU	U		
		AUC	ACC	AAC	AGC	C		
		AUA	ACA	AAA	AGA	A		
		AUG Met or start	ACG	AAG	AGG	G		
	G	GUU	GCU	GAU	GGU	U		
		GUC	GCC	GAC	GGC	C		
		GUA	GCA	GAA	GGA	A		
		GUG	GCG	GAG	GGG	G		

Fig. 17-6a



**(a) Tobacco plant expressing
a firefly gene**

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(b) Pig expressing a jellyfish gene

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Samengevat

De genetische code is universeel

Alle organismen gebruiken DNA dat wordt vertaald naar RNA wat vaak de codering is voor een proteïne (eiwit)

17.2 Transcriptie

Transcriptie

Transcriptie is het kopiëren van DNA naar RNA

Fig. 17-7

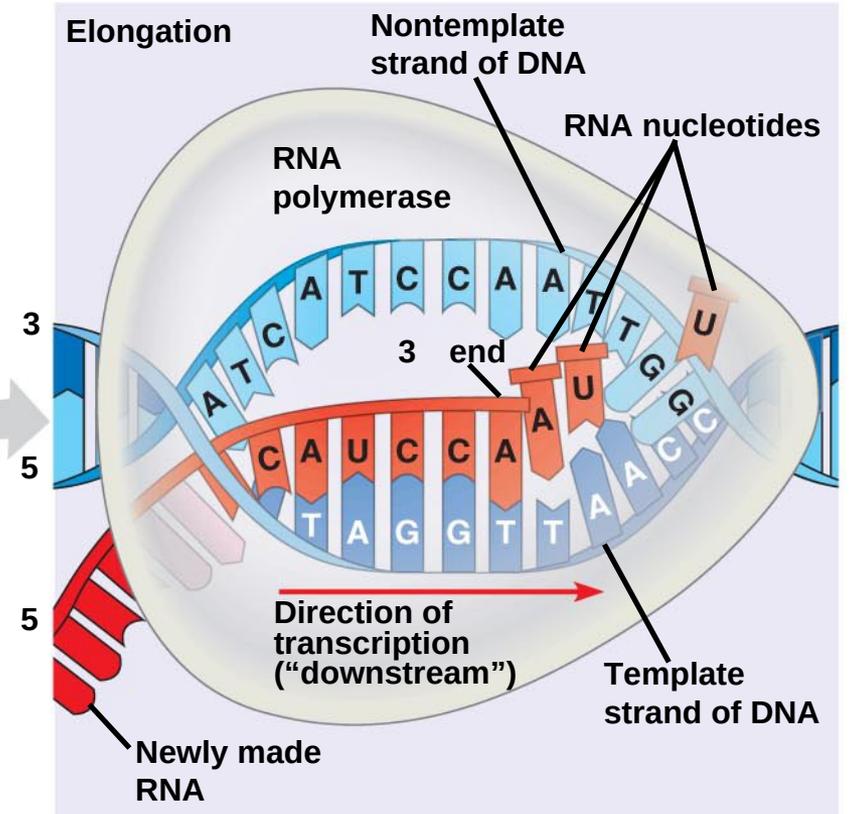
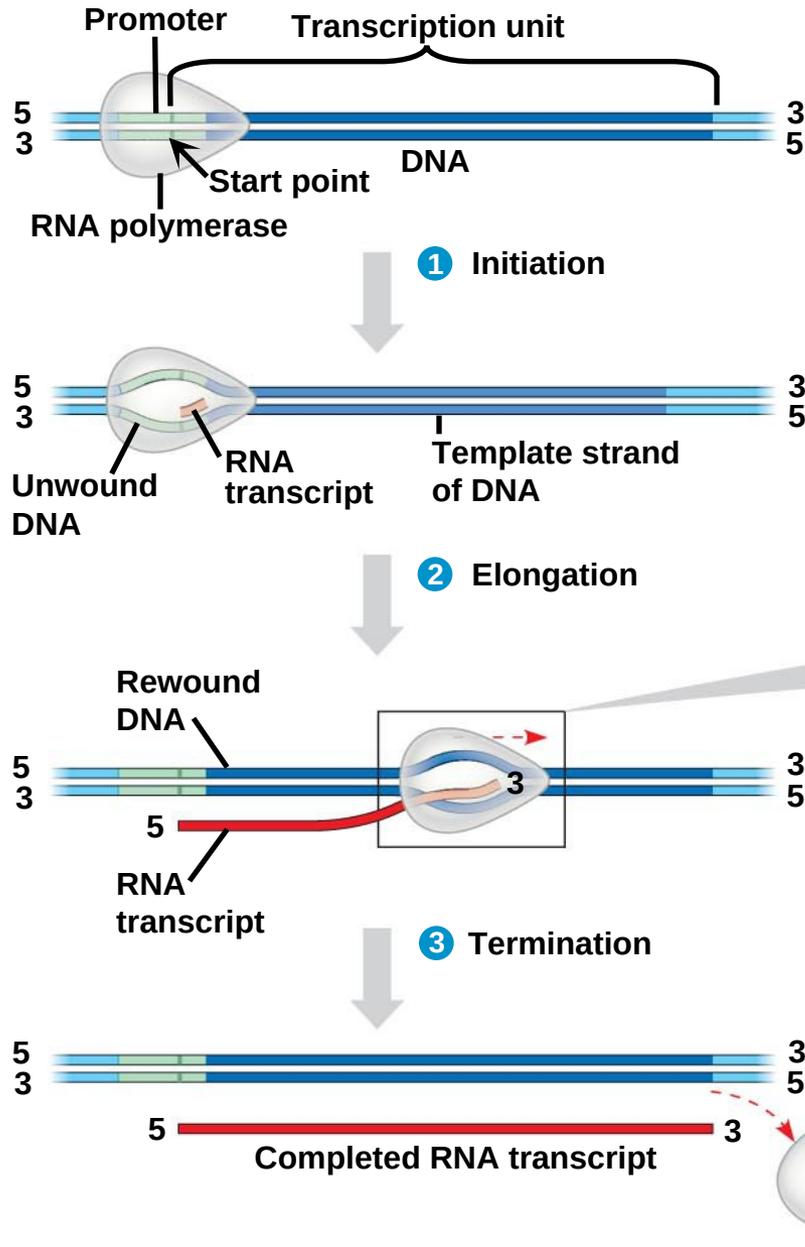


Fig. 17-7a-1

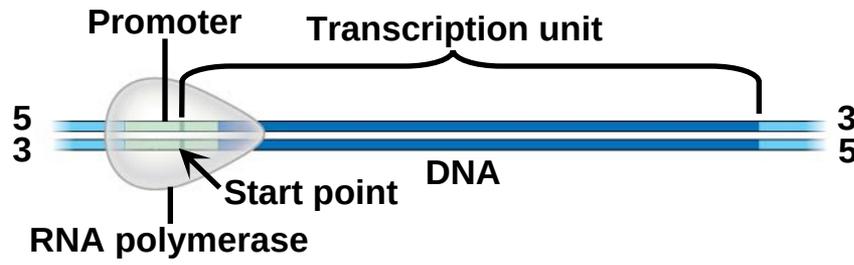


Fig. 17-7a-2

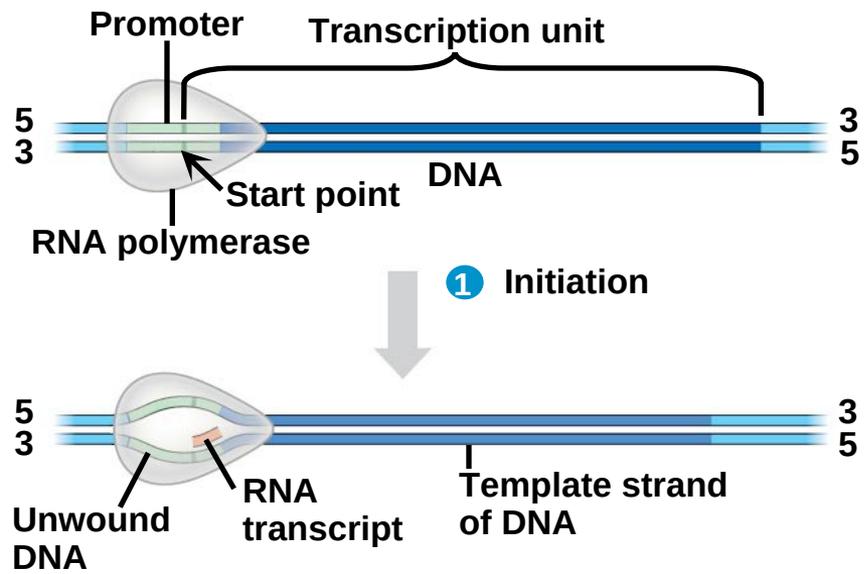


Fig. 17-7a-3

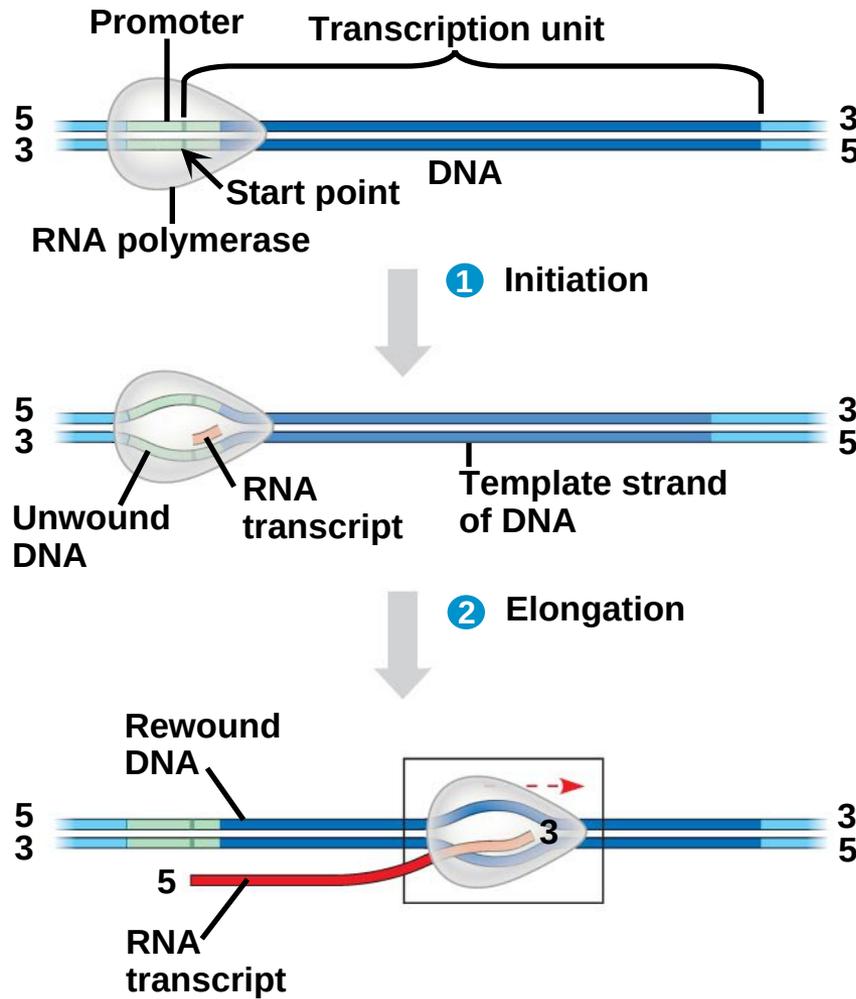


Fig. 17-7a-4

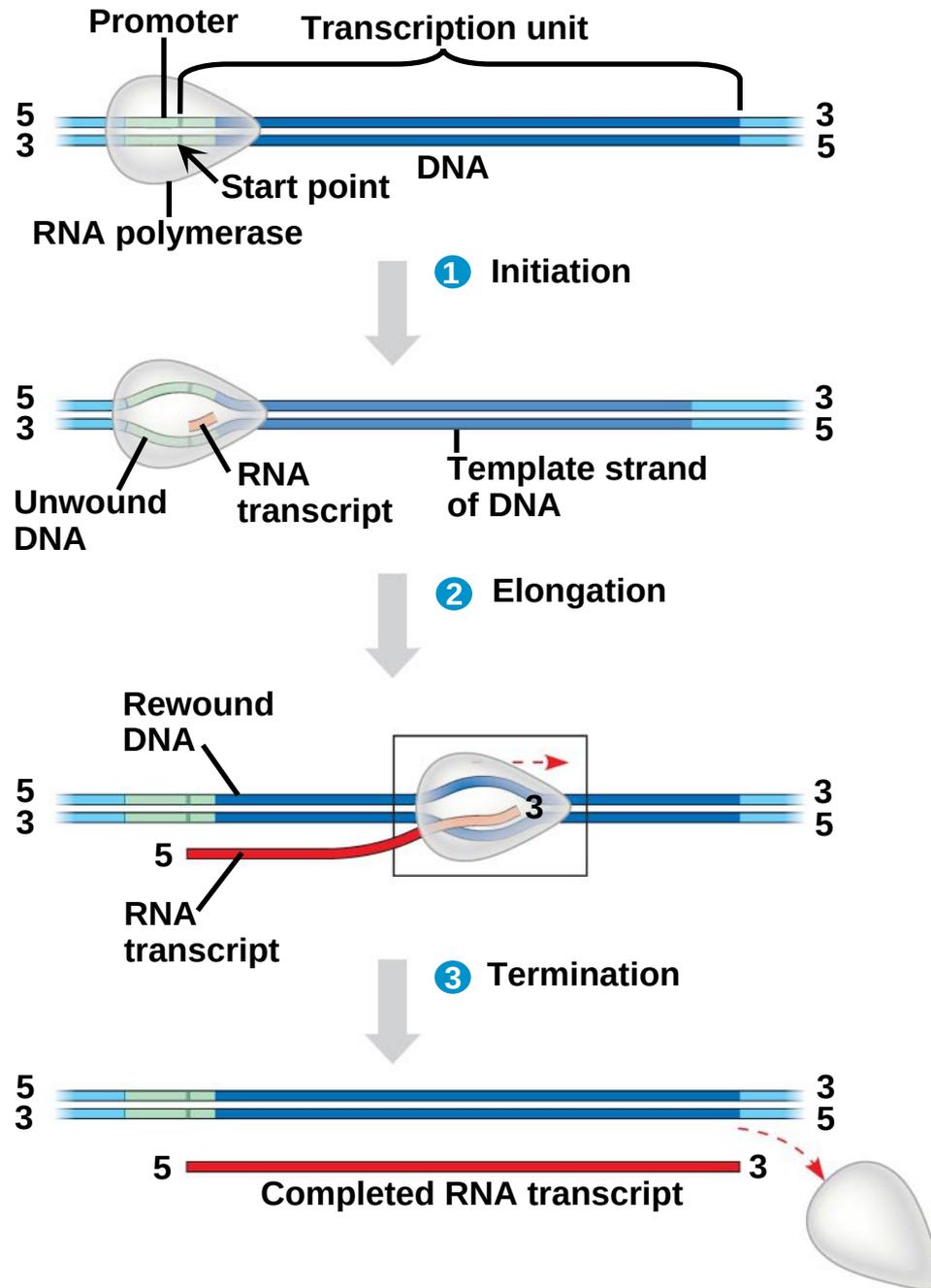
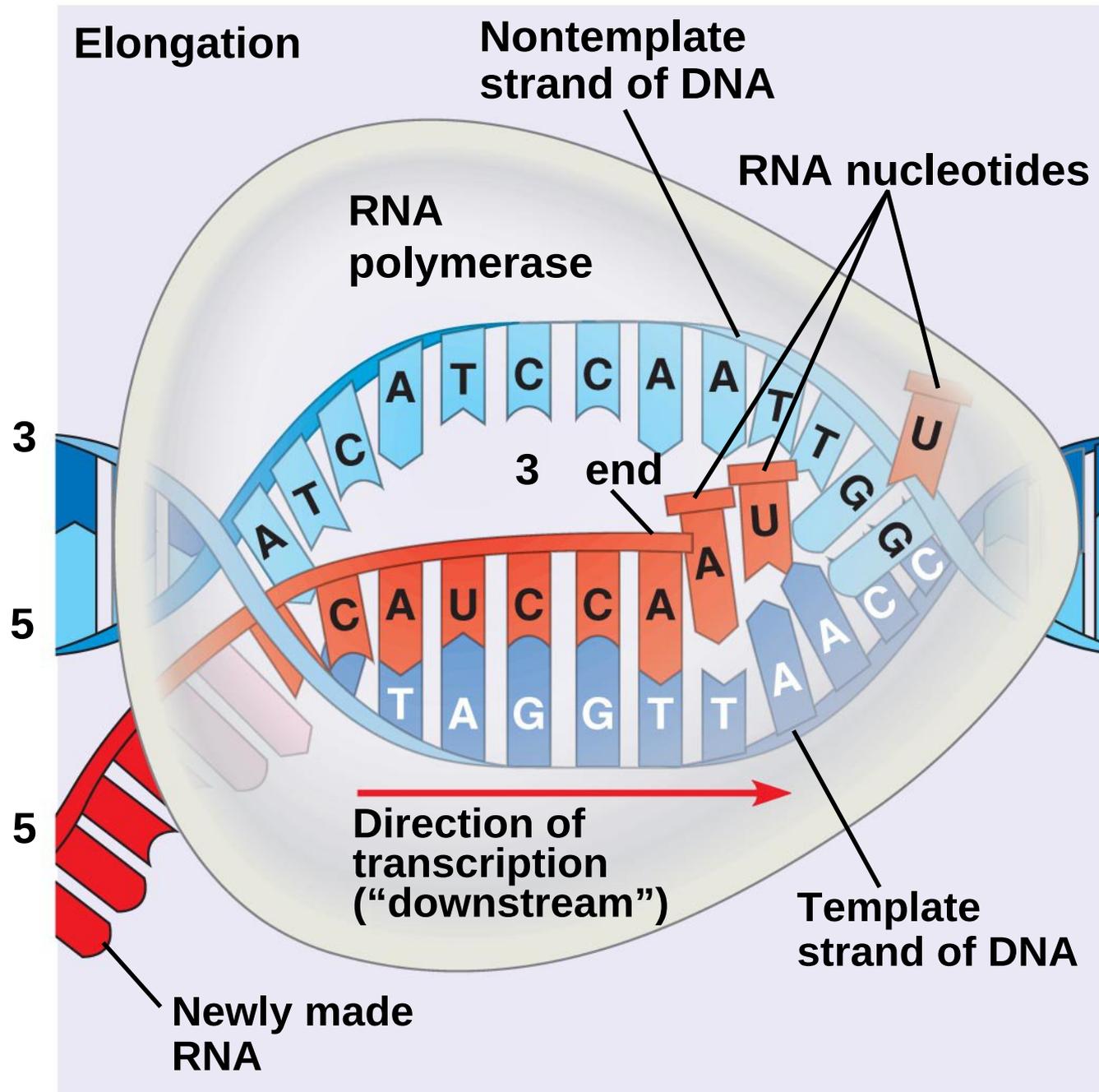


Fig. 17-7b



Stadia

De stadia van transcriptie

- Initiatie
- Elongatie
- Terminatie

Initiatie

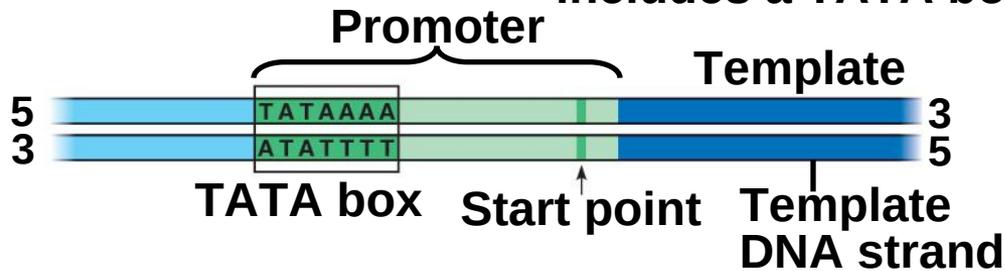
Of een transcriptie start is afhankelijk van verschillende factoren

Onder andere de aanwezigheid van transcriptiefactoren bepaalt of RNA-Polymerase II zal binden aan het DNA

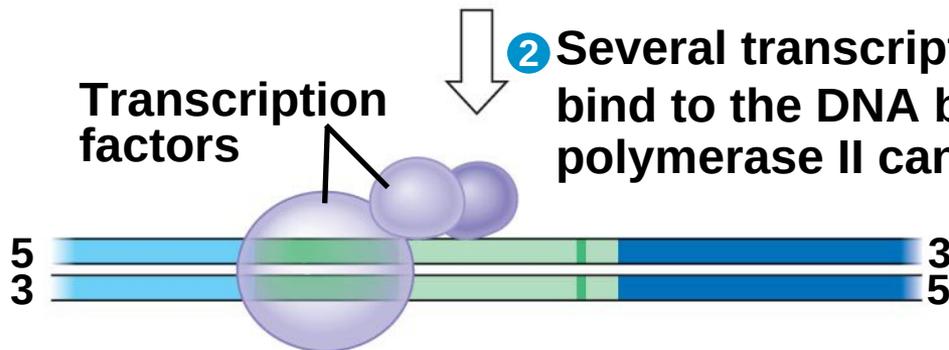
Zo kan een transcriptie initialisatie complex worden gevormd

In eukaryoten is vaak een promoter met TATA cruciaal voor initialisatie

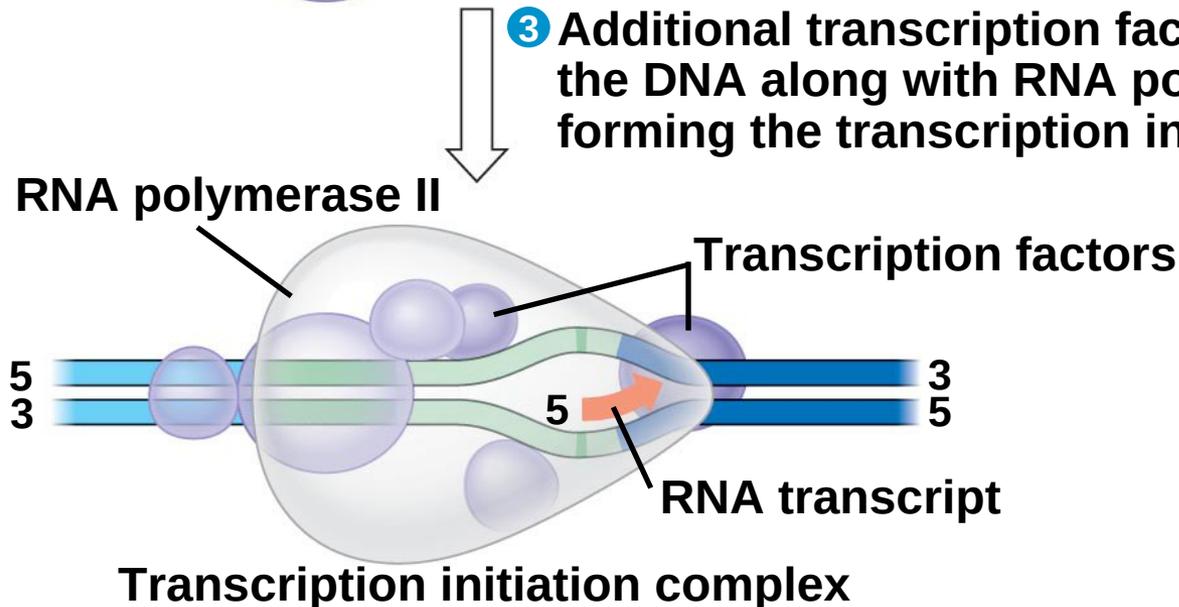
1 A eukaryotic promoter includes a TATA box



2 Several transcription factors must bind to the DNA before RNA polymerase II can do so.



3 Additional transcription factors bind to the DNA along with RNA polymerase II, forming the transcription initiation complex.



Eukaryoten modificeren RNA na transcriptie

RNA processing

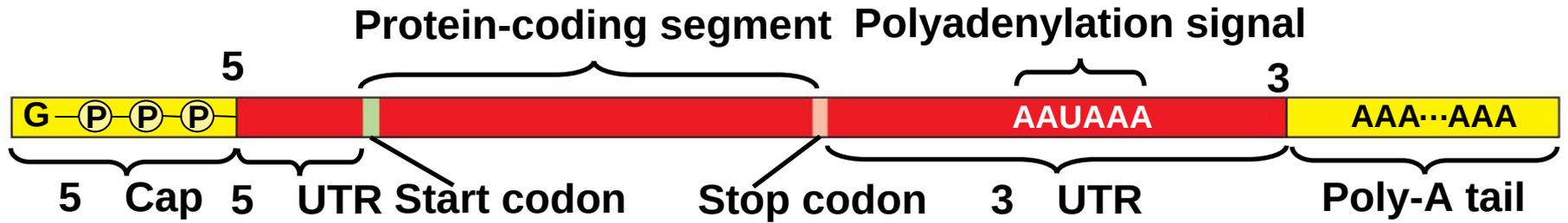
Na transcriptie vindt in eukaryoten modificatie van het pre-mRNA plaats

Deze modificaties tezamen wordt processing genoemd

Processing

Wijzigingen aan 5' en 3' kant van mRNA
Verwijderen van intronen

Fig. 17-9



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Eukaryoten

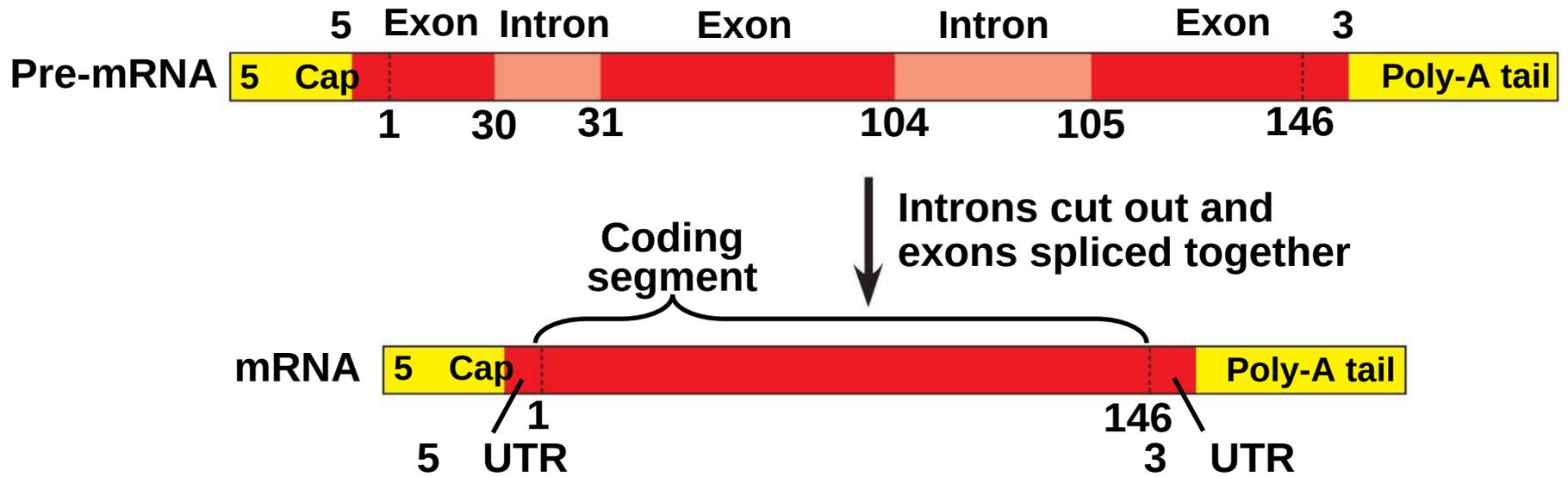
Eukaryotische genen bevatten niet coderende stukken intronen
(**int**ervening **regi**ons)

De coderende stukken gen noemen we exonen (**ex**pressed **regi**ons)

Splicing

Het proces van verwijderen van intronen uit genen noemen we splicing

Fig. 17-10

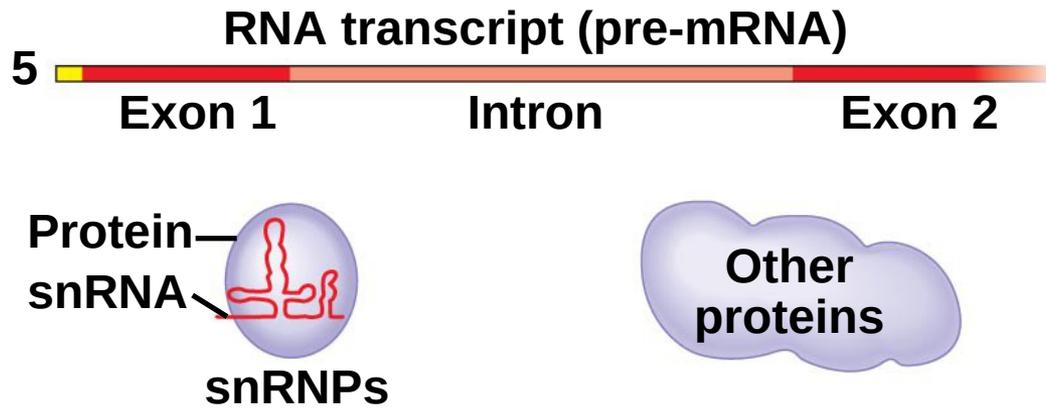


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Spliceosomen

In een aantal gevallen zijn spliceosomen betrokken bij splicing

Fig. 17-11-1



*snRNP = small
nuclear
ribonucleo-
proteins*

Fig. 17-11-2

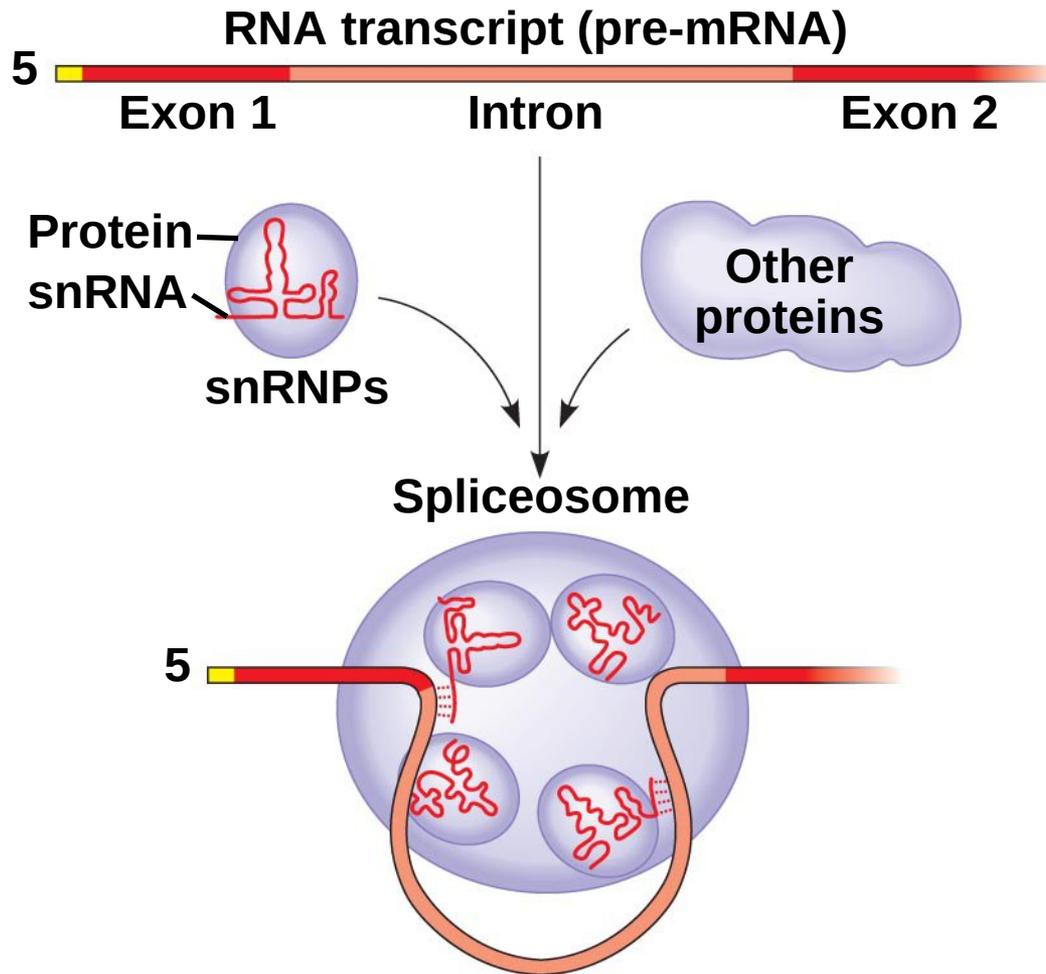
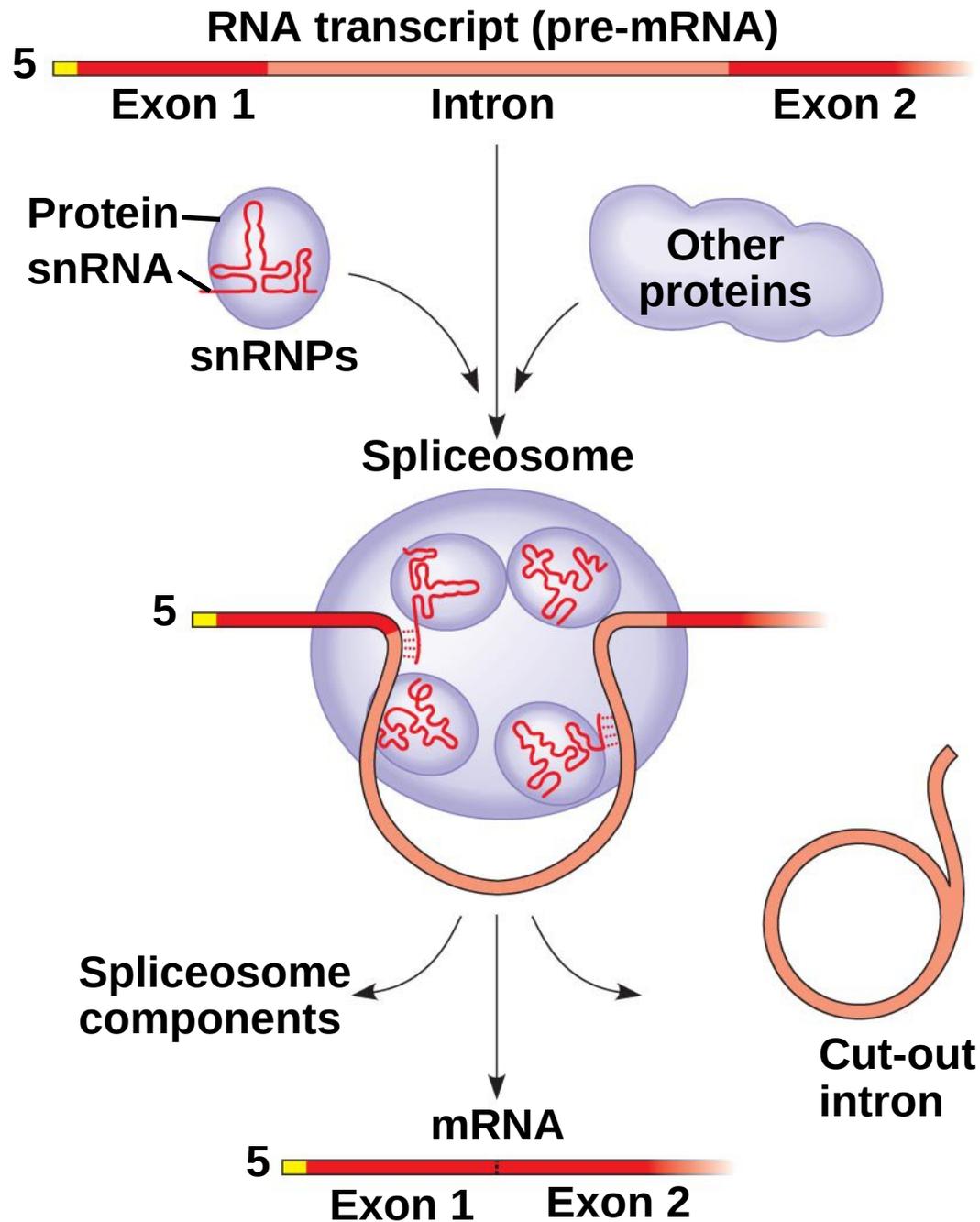


Fig. 17-11-3



Vraag

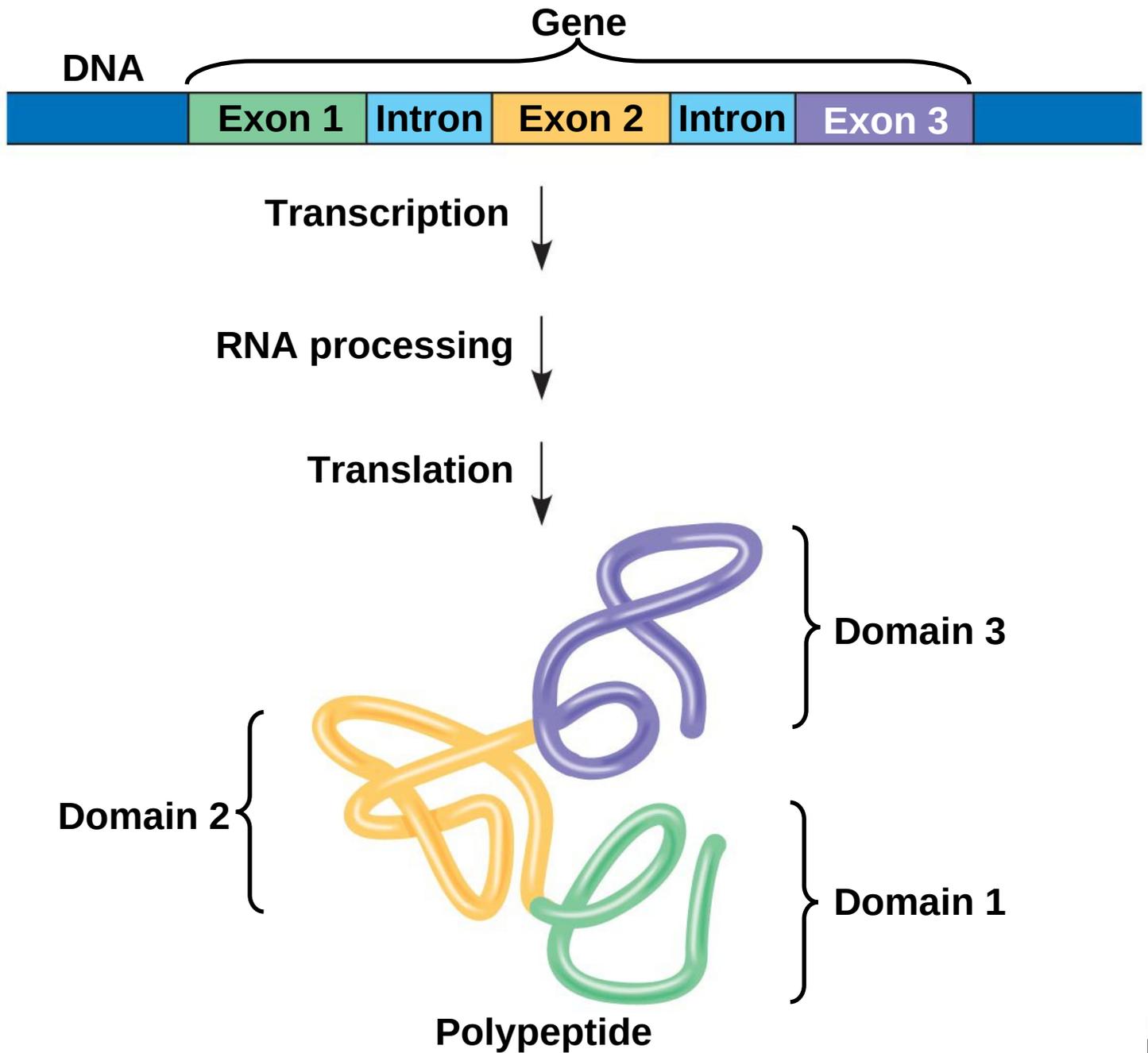
Wat zal de reden kunnen zijn dat eukaryoten genen splicen?

Wat gebeurt er met een gen dat we overzetten uit de mens in een bacterie?

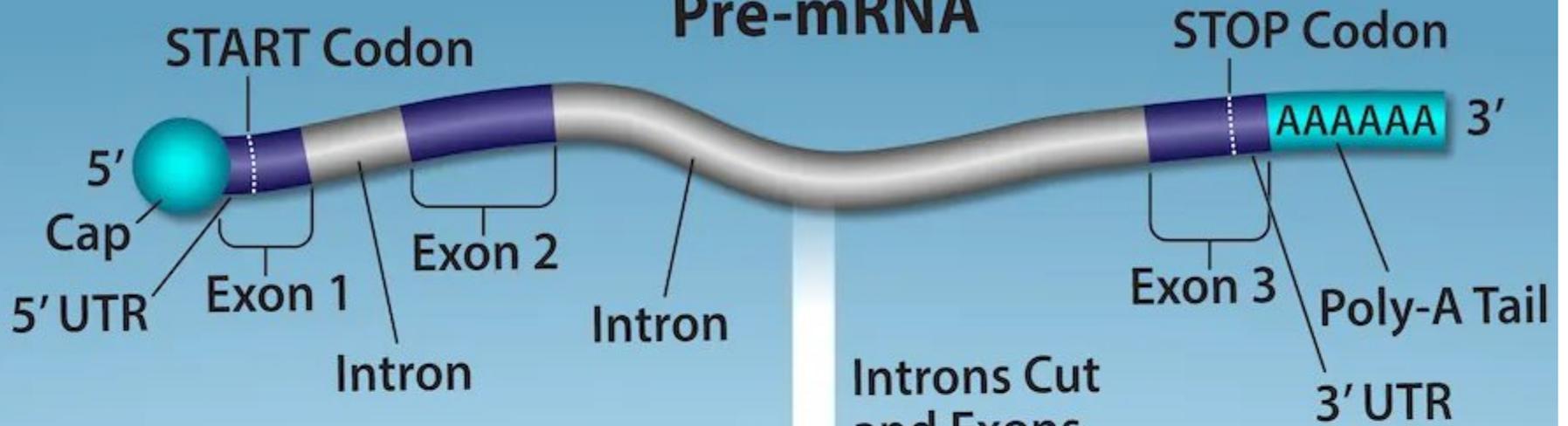
Vraag

Hoe kunnen we in een bacterie toch succesvol het menselijke insuline gen tot expressie brengen?

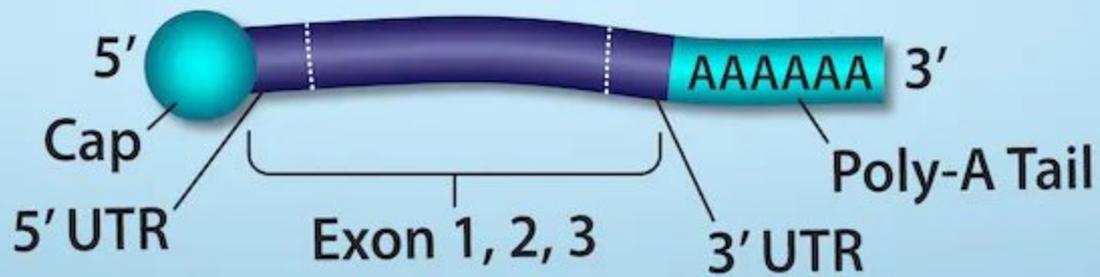
Fig. 17-12



Pre-mRNA



mRNA



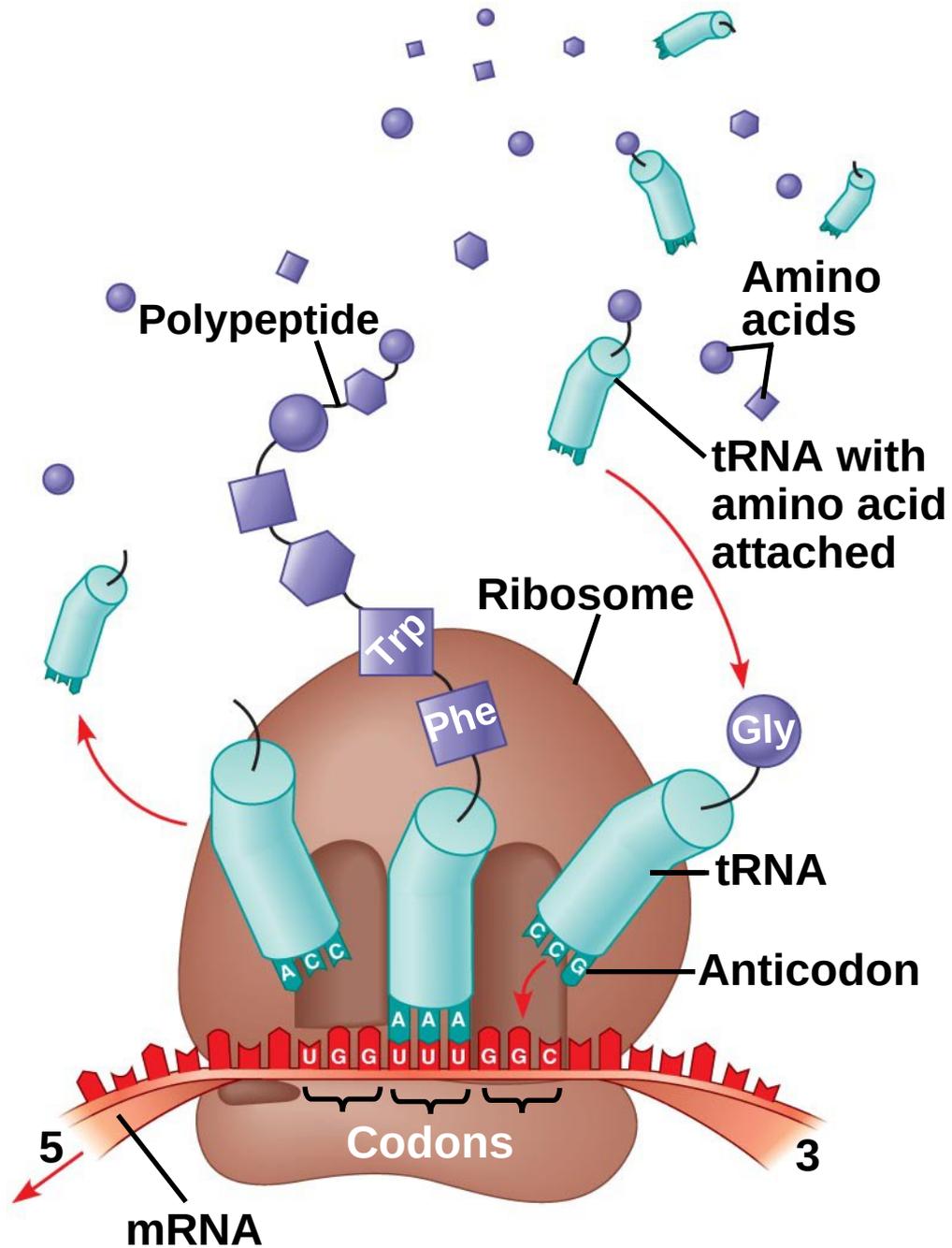
Translatie

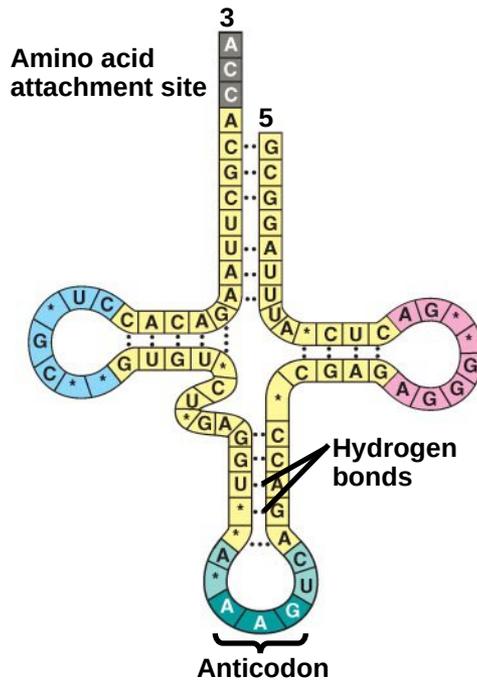
Translatie

Translatie is de bouw van een polypeptiden op basis van de codering in het mRNA

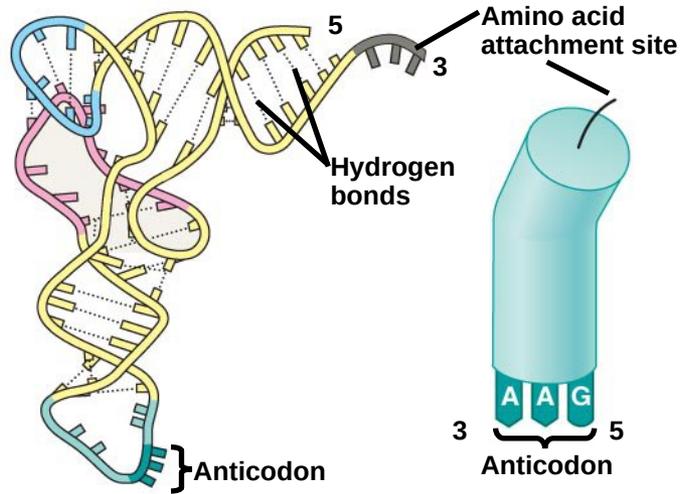
Hierbij zijn onder andere ribosomen en tRNA moleculen betrokken

Fig. 17-13



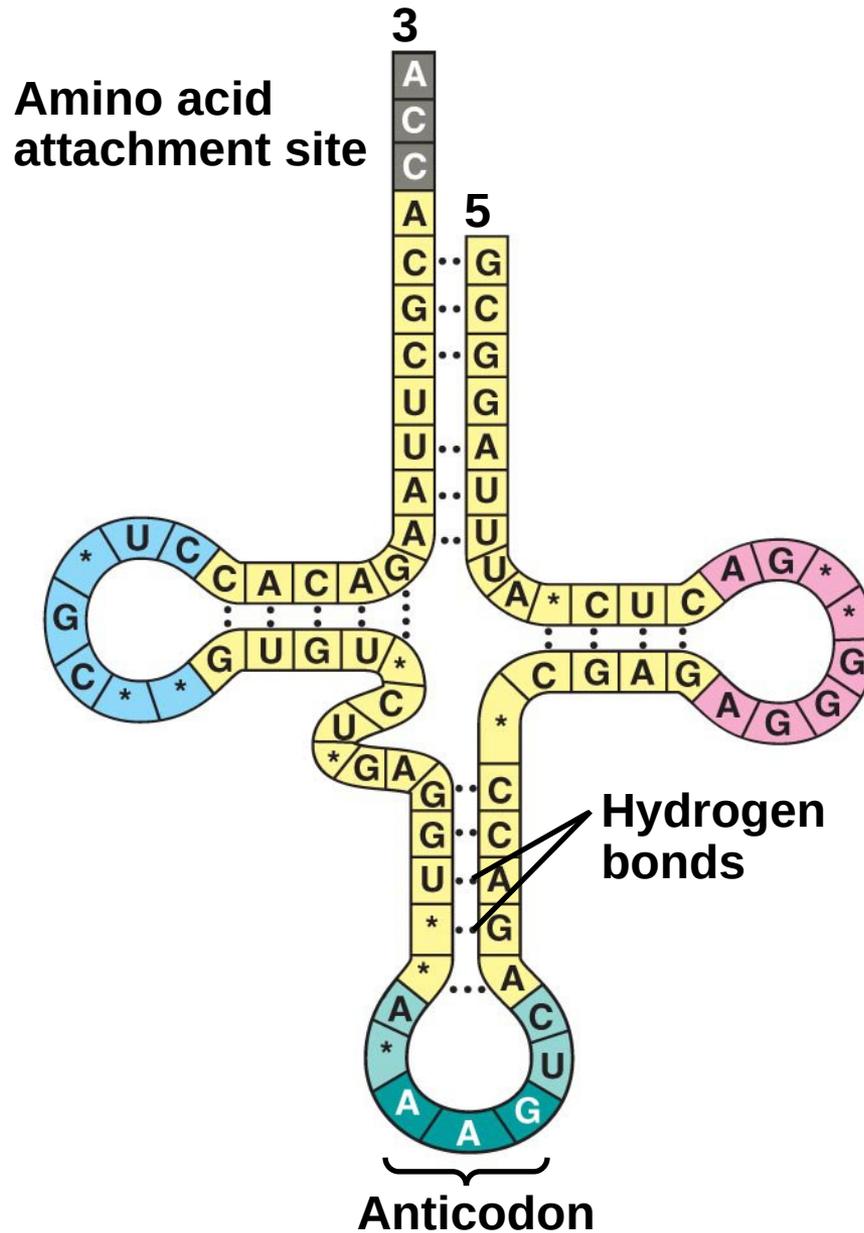


(a) Two-dimensional structure

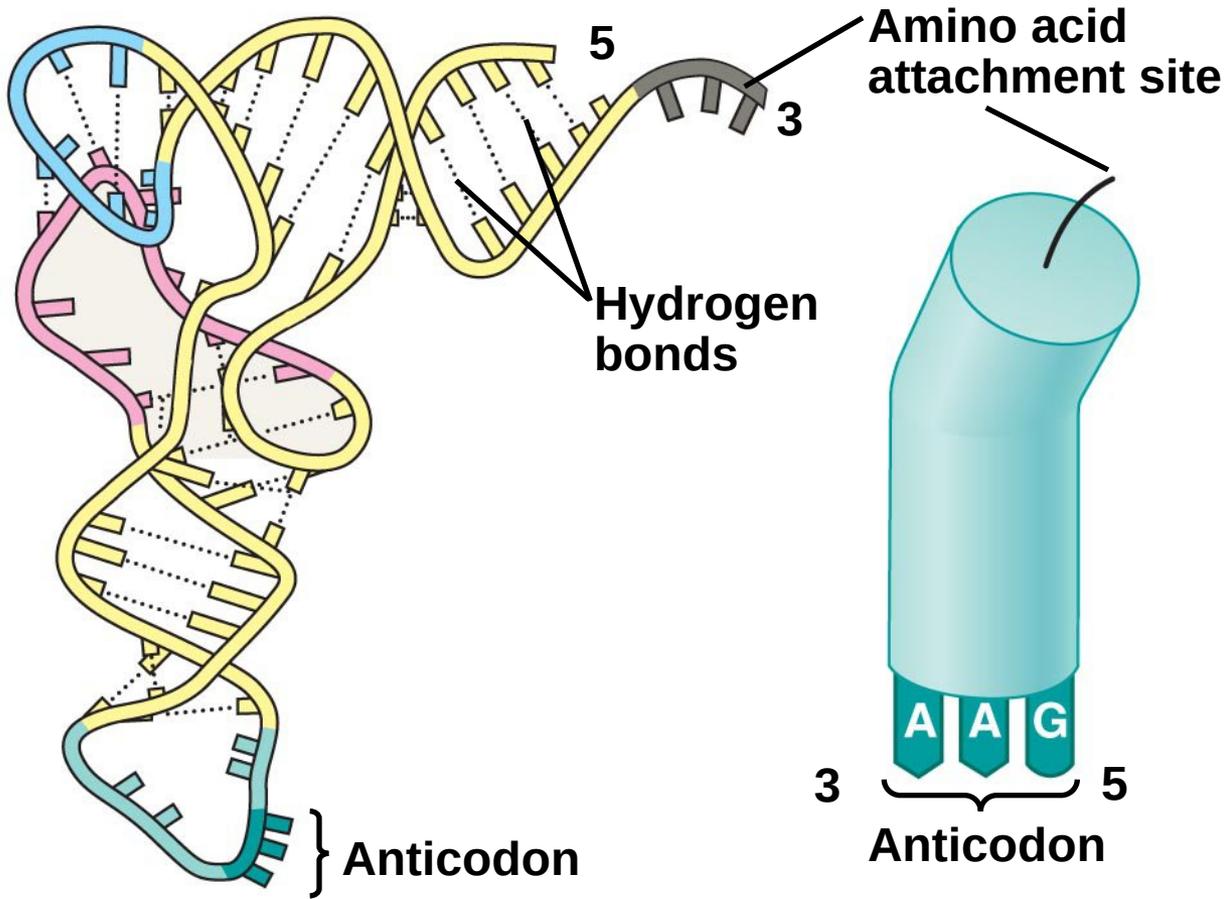


(b) Three-dimensional structure

(c) Symbol used in this book



(a) Two-dimensional structure



(b) Three-dimensional structure

(c) Symbol used in this book

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Ribosome Structure

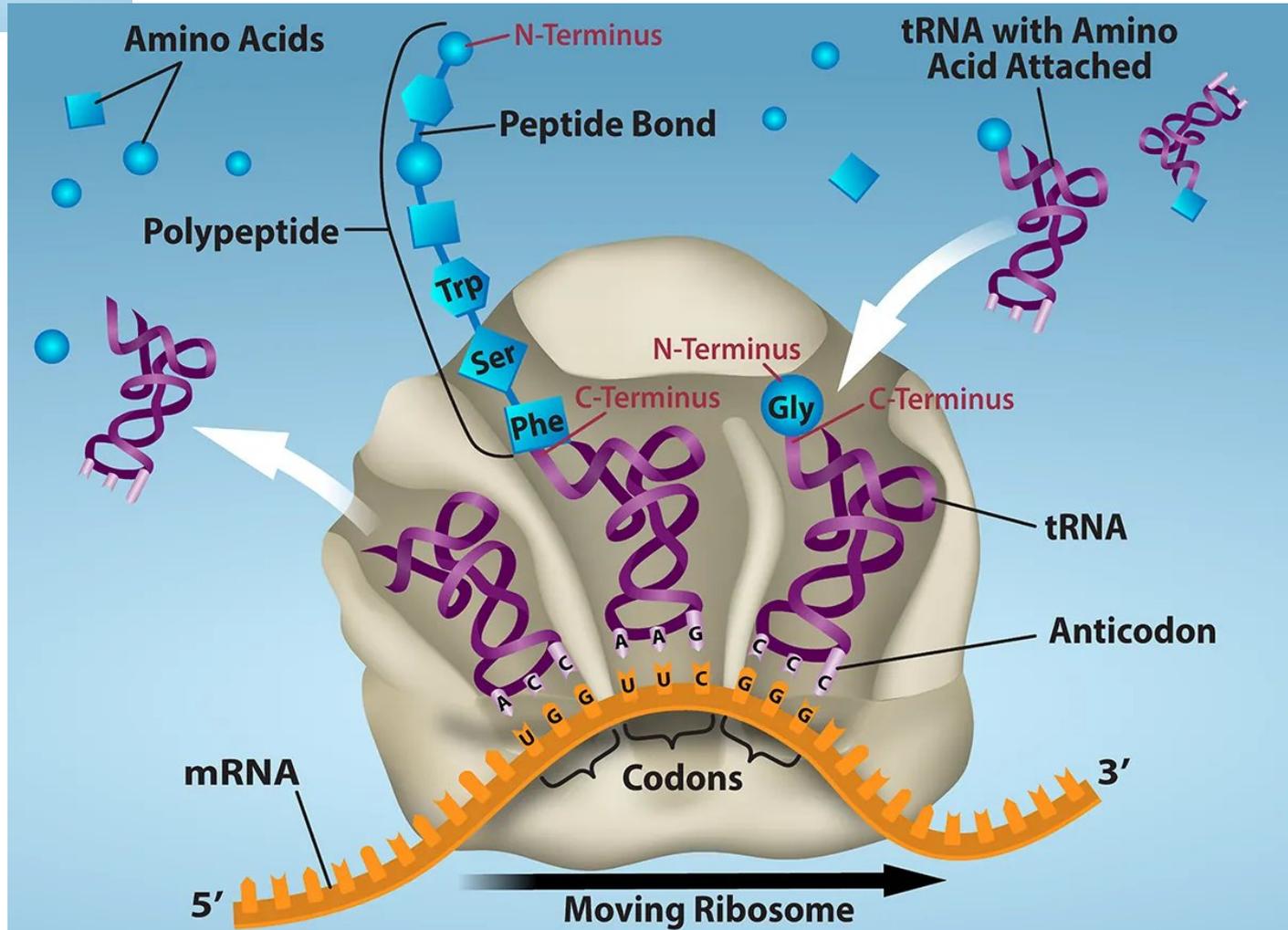
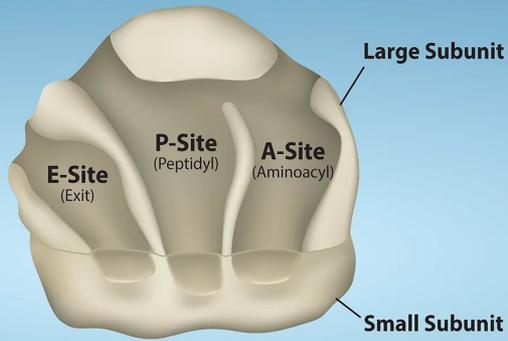


Fig. 17-15-1

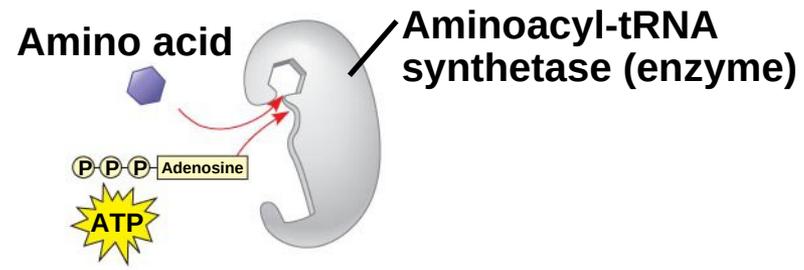


Fig. 17-15-2

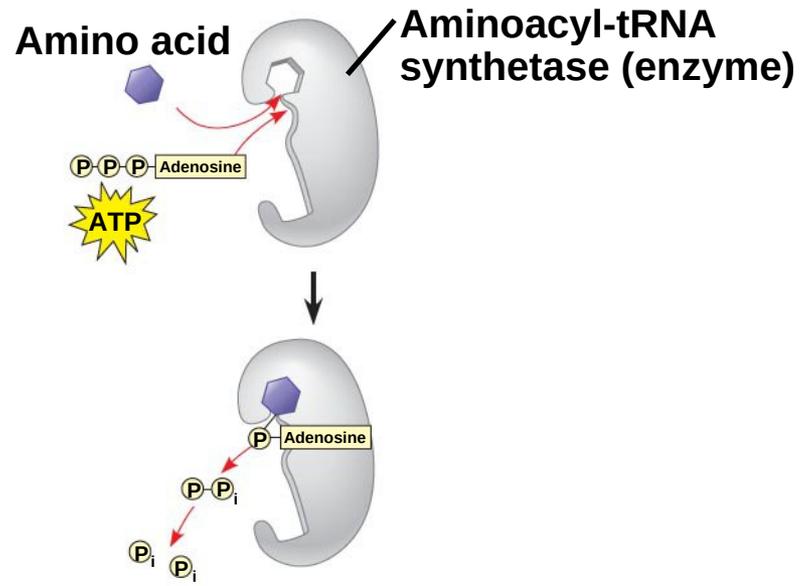


Fig. 17-15-3

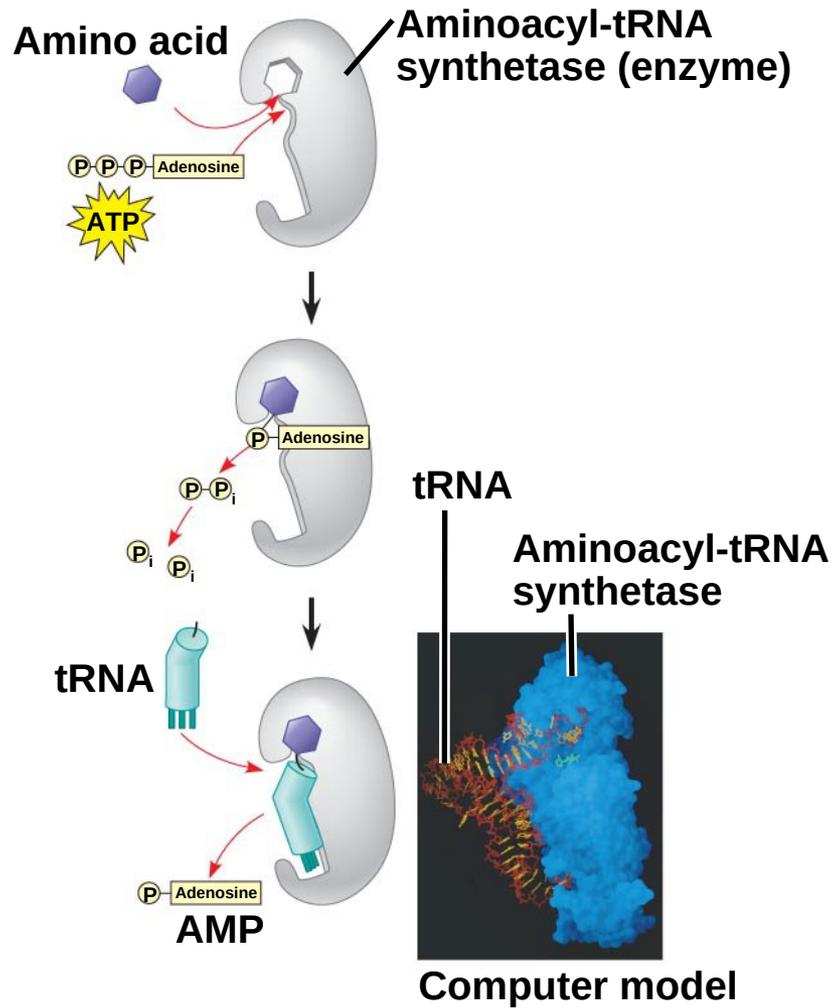
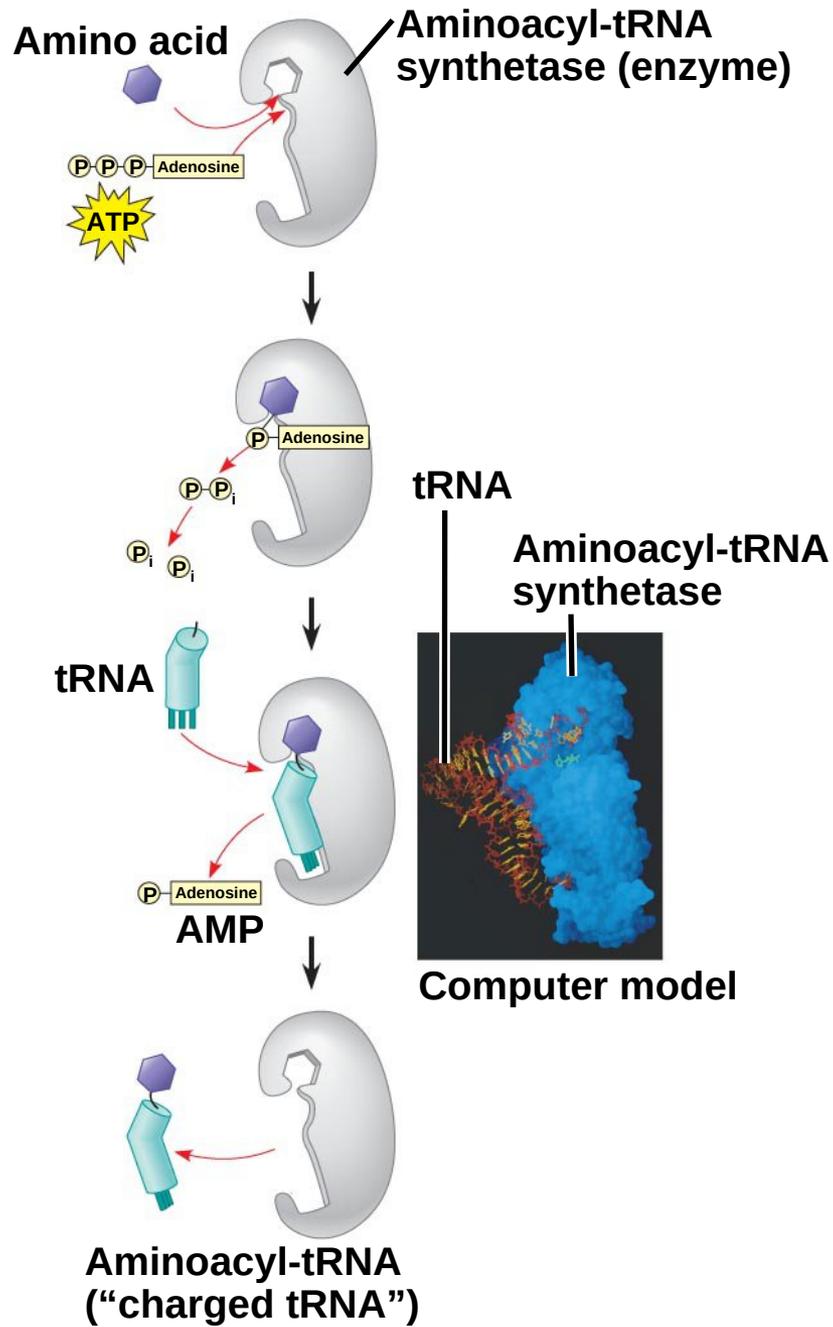


Fig. 17-15-4



Ribosomen

Ribosomen zijn grote eiwitten die de synthese van polypeptiden uitvoeren

Ribosomen bestaan uit twee subunits

Er is een grote subunit en een kleine subunit

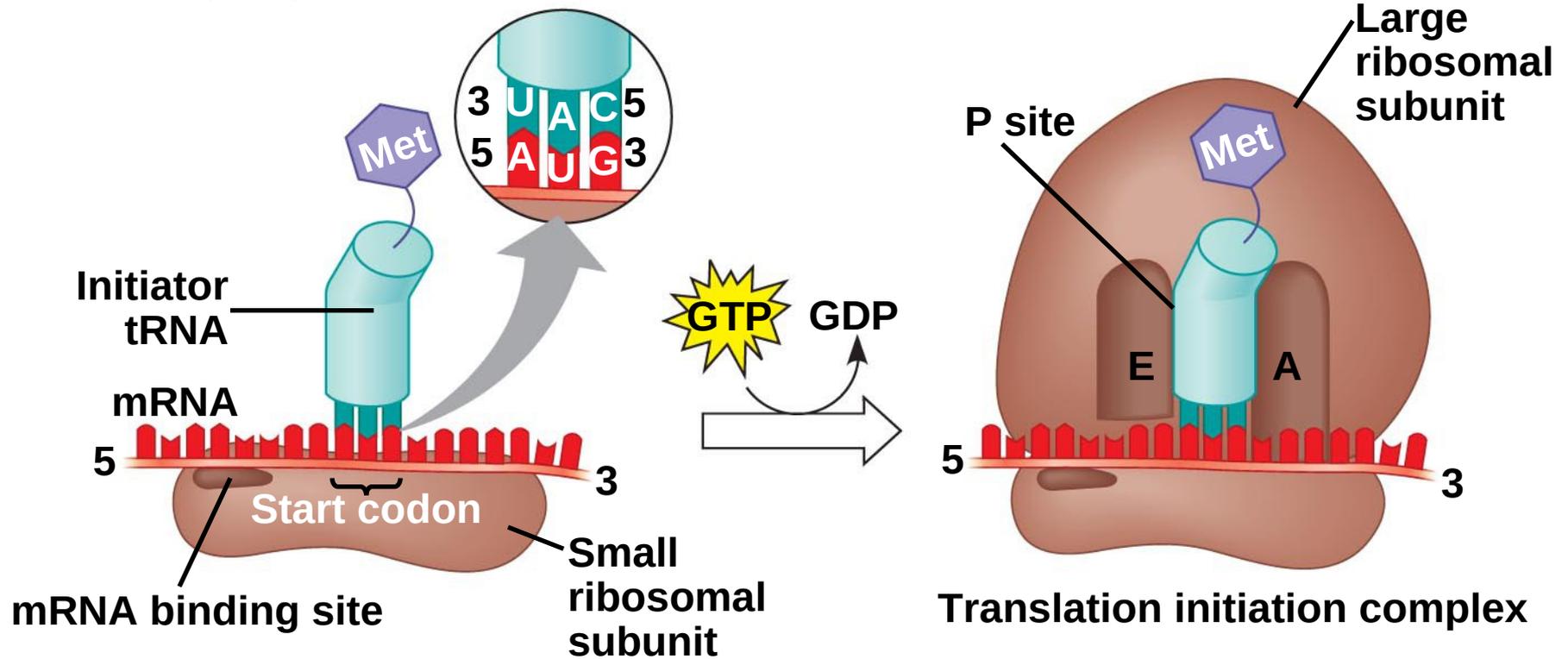
In het ribosoom zit ook RNA: rRNA

Translatie

Translatie bestaat uit drie stappen

- Initiatie
- Elongatie
- Terminatie

Initiation



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Elongatie

Fig. 17-18-1

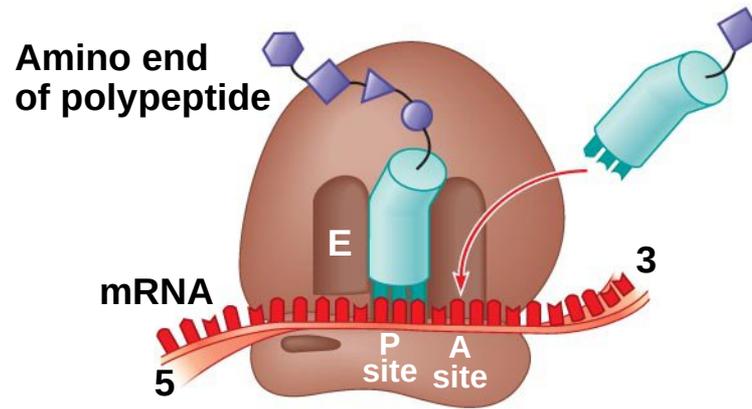


Fig. 17-18-2

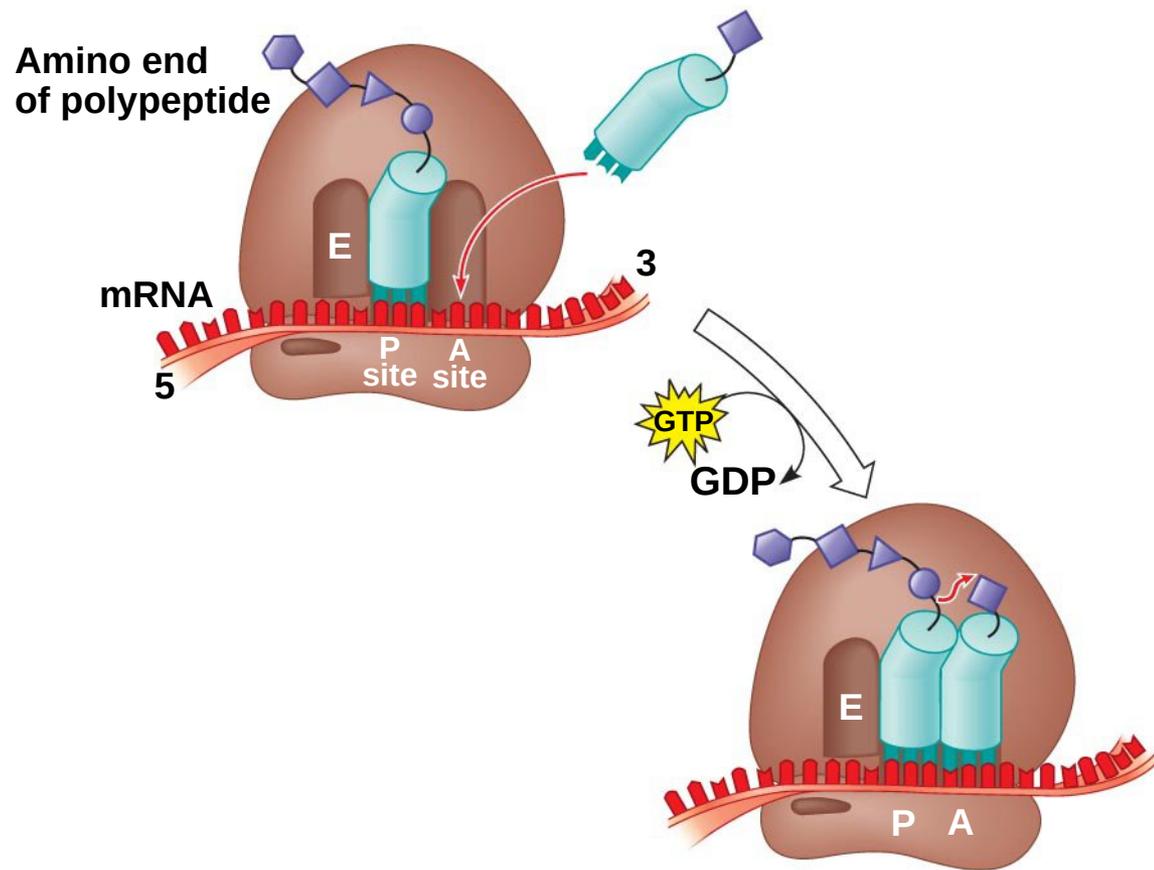


Fig. 17-18-3

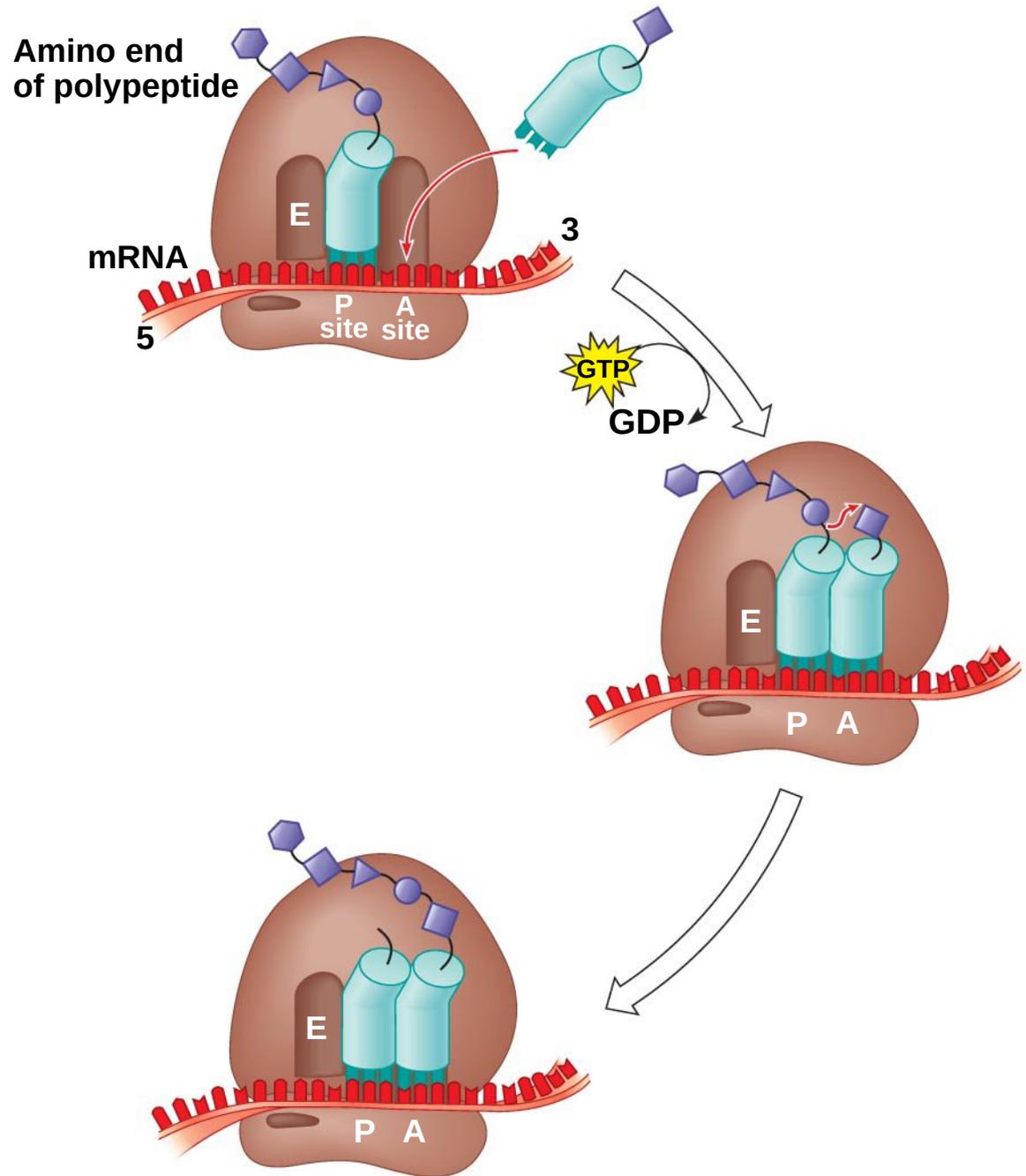
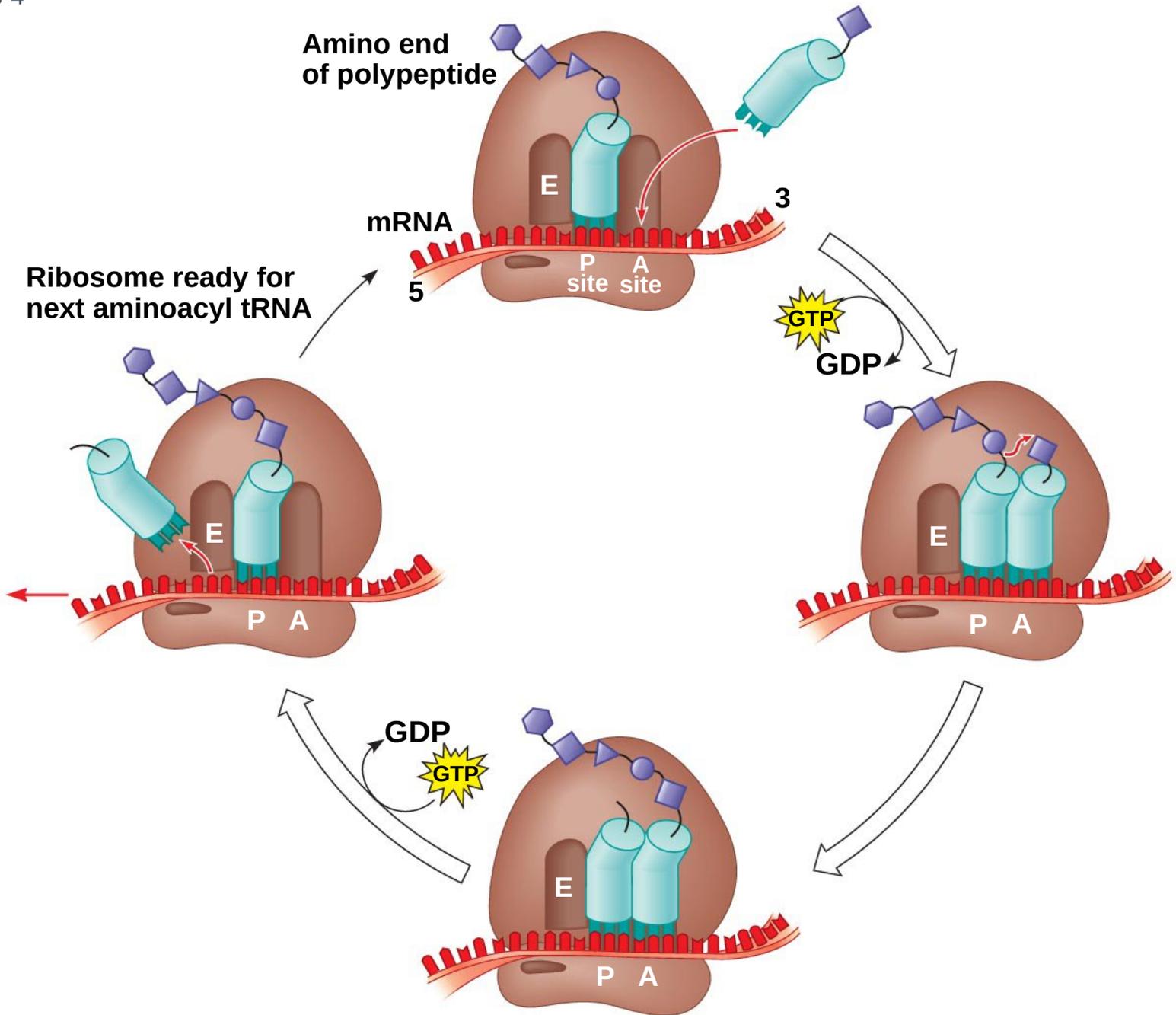


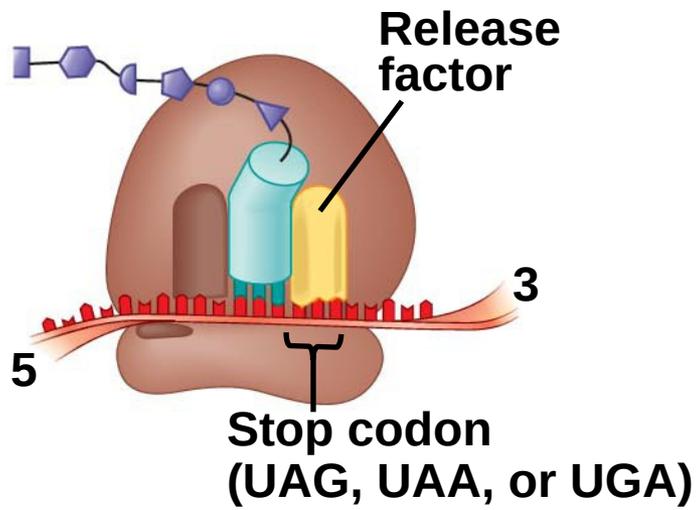
Fig. 17-18-4



Terminatie

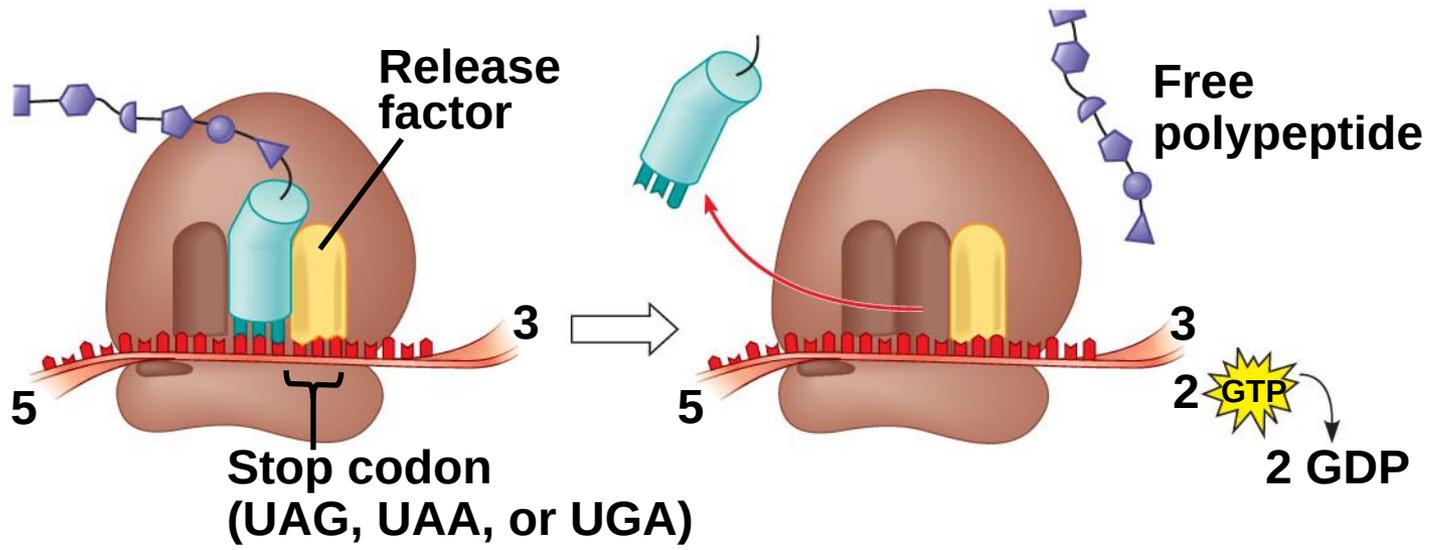
Indien een stop codon wordt aangetroffen is daar geen tRNA voor
Hier stopt de elongatie: terminatie

Fig. 17-19-1



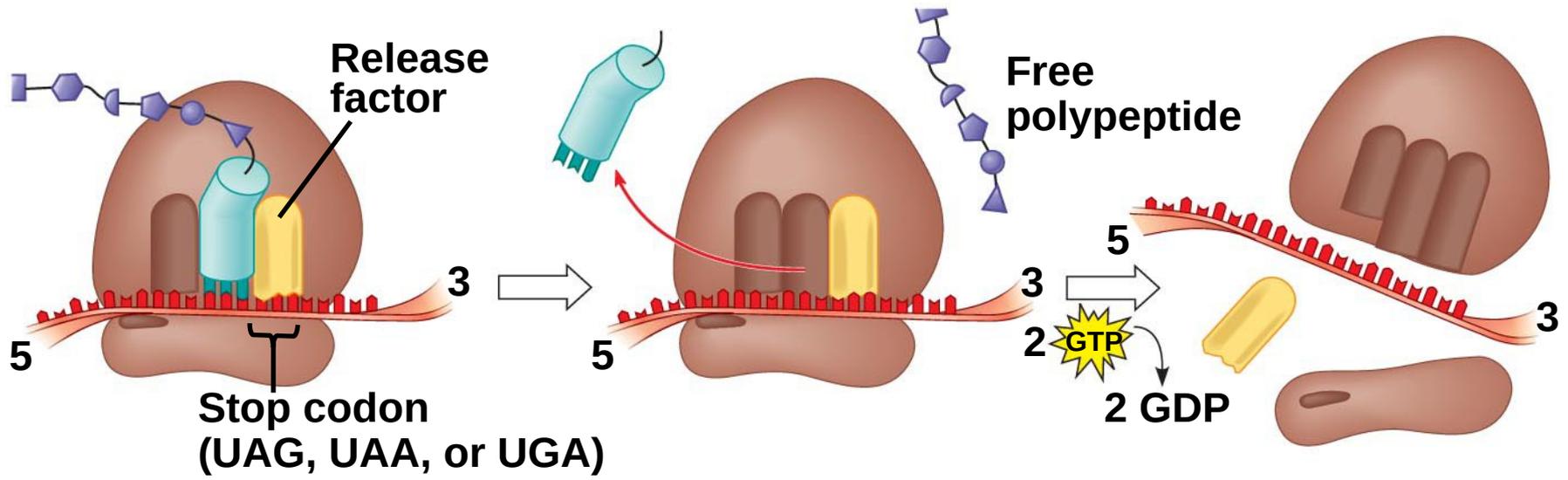
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Fig. 17-19-2

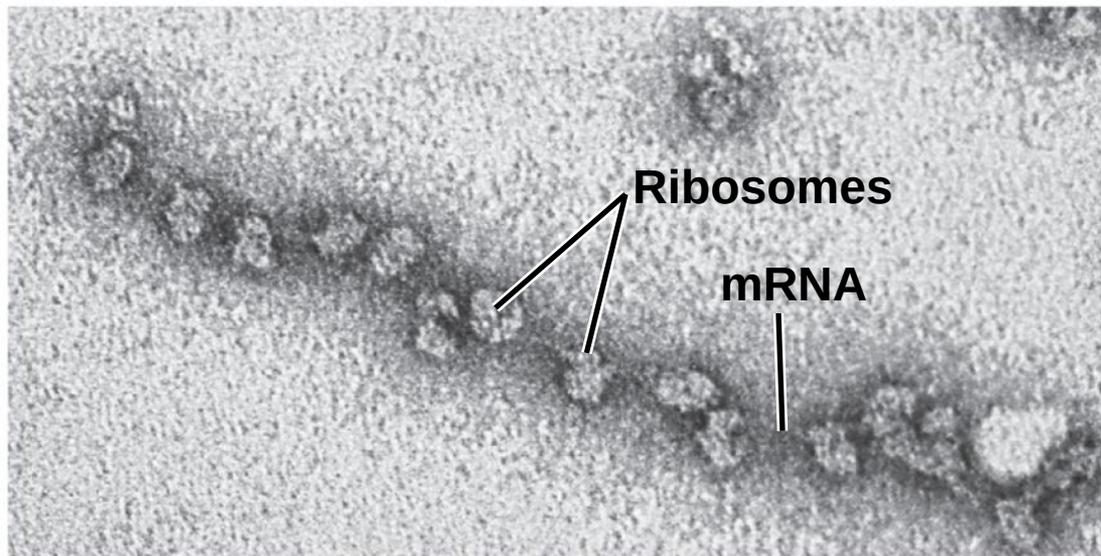
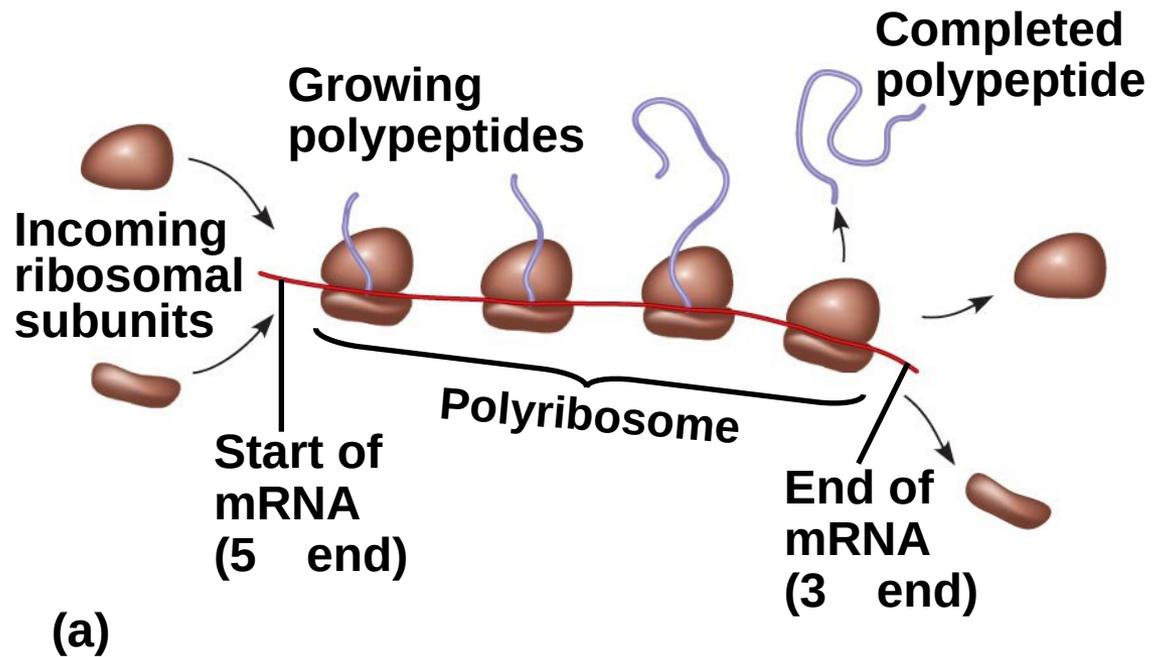


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Fig. 17-19-3



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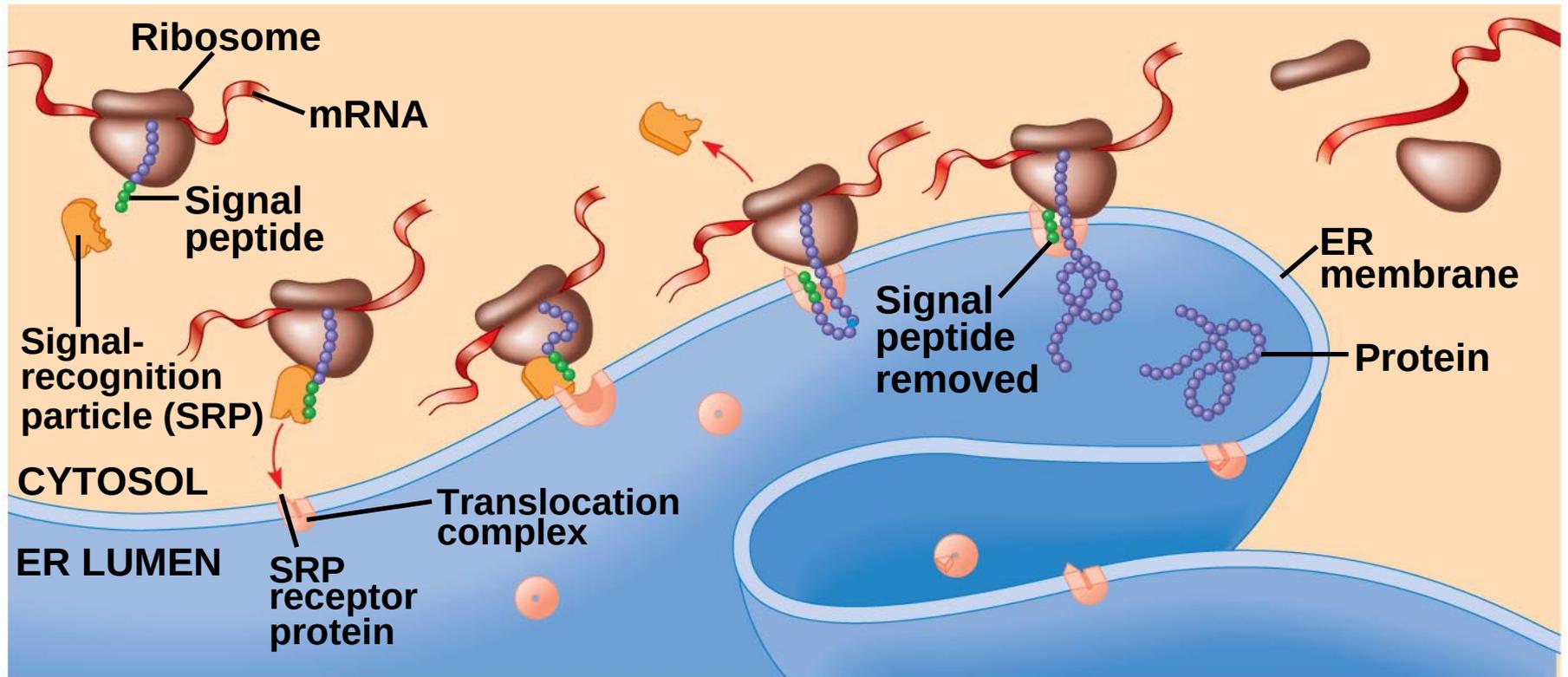
(b)

Na de translatie...

Na de translatie worden de meeste polypeptiden nog gemodificeerd voordat ze werkzaam zijn

Daarna worden de proteïnen naar de juiste locatie in de cel gebracht

Fig. 17-21



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Vraag

Wat is het verschil tussen een polypeptide en een proteïne?

Wat is het verschil in translatie tussen pro- en eukaryoten

Vraag

Coding streng =
3'TAT CAT CCT GGG 5'

Polypeptide?

		Second mRNA base						
		U	C	A	G			
U	UUU	Phe	UCU	UAU	UGU	U		
	UUC						Ser	UAC
	UUA	Leu	UCA	UAA	Stop	UGA		
	UUG			UCG	UAG	Stop	UGG	Trp
C	CUU	Leu	CCU	CAU	CGU	U		
	CUC						Pro	CAC
	CUA	CCA	CAA	CGA	A			
	CUG					CCG	CAG	CGG
A	AUU	Ile	ACU	AAU	AGU	U		
	AUC						Thr	AAC
	AUA	ACA	AAA	AGA	A			
	AUG					Met or start	ACG	AAG
G	GUU	Val	GCU	GAU	GGU	U		
	GUC						Ala	GAC
	GUA	GCA	GAA	GGA	A			
	GUG					GCG	GAG	GGG

17.5 Punt mutaties

Punt mutatie

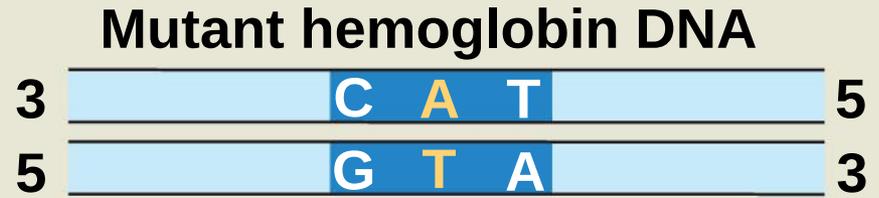
Punt mutaties zijn chemische wijzigingen op slechts een basepaar van een gen

Dit kan leiden tot een ander aminozuur

Vraag

Wanneer zal een puntmutatie geen gevolgen hebben op het polypeptide

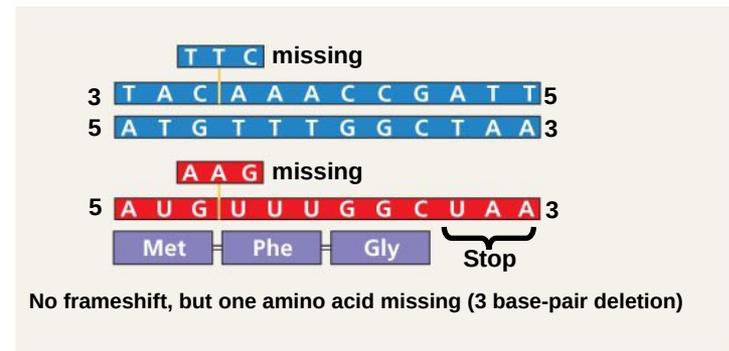
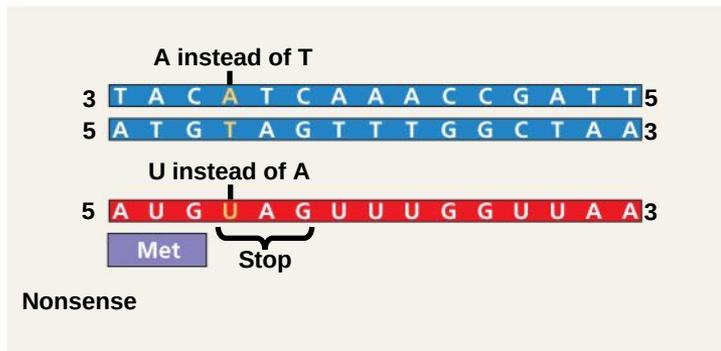
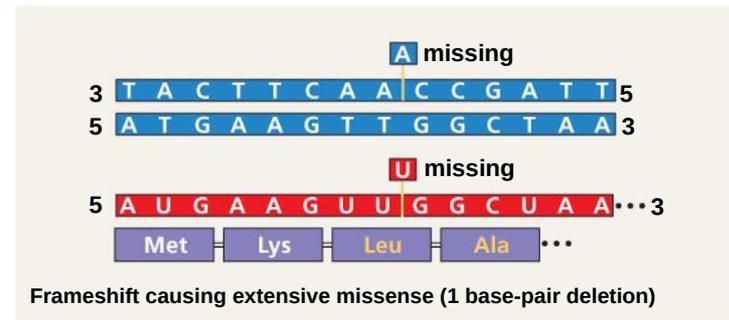
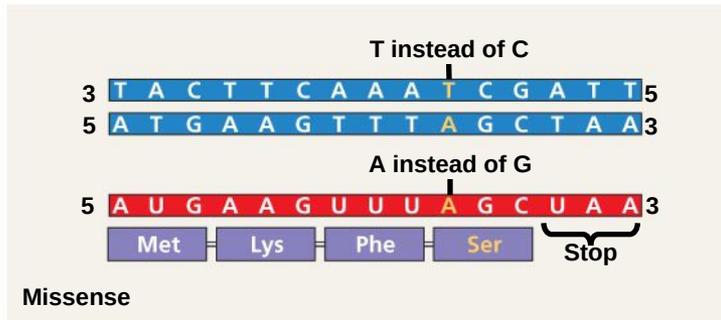
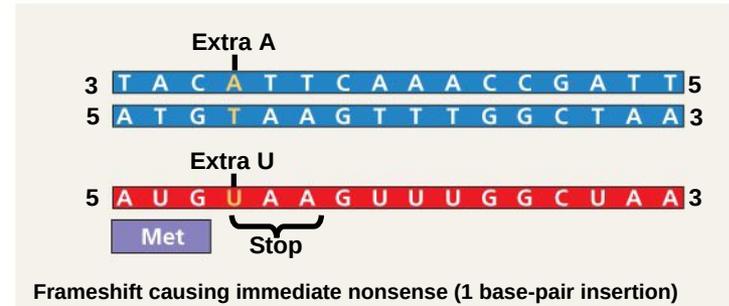
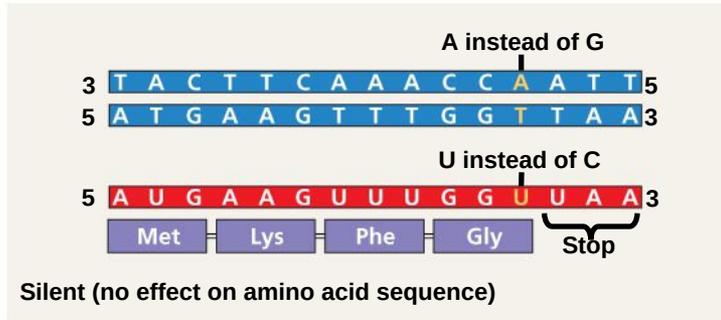
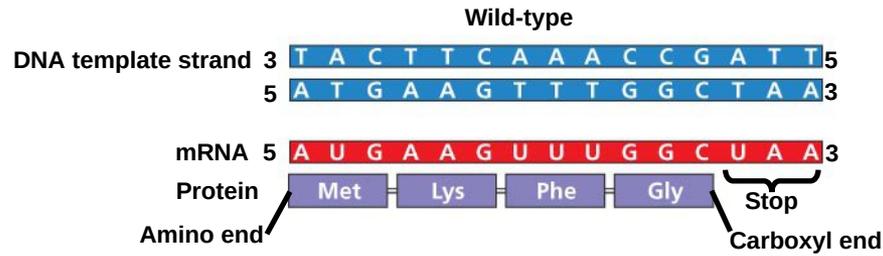
Fig. 17-22



Type puntmutaties

Er zijn twee hoofd categorieën:

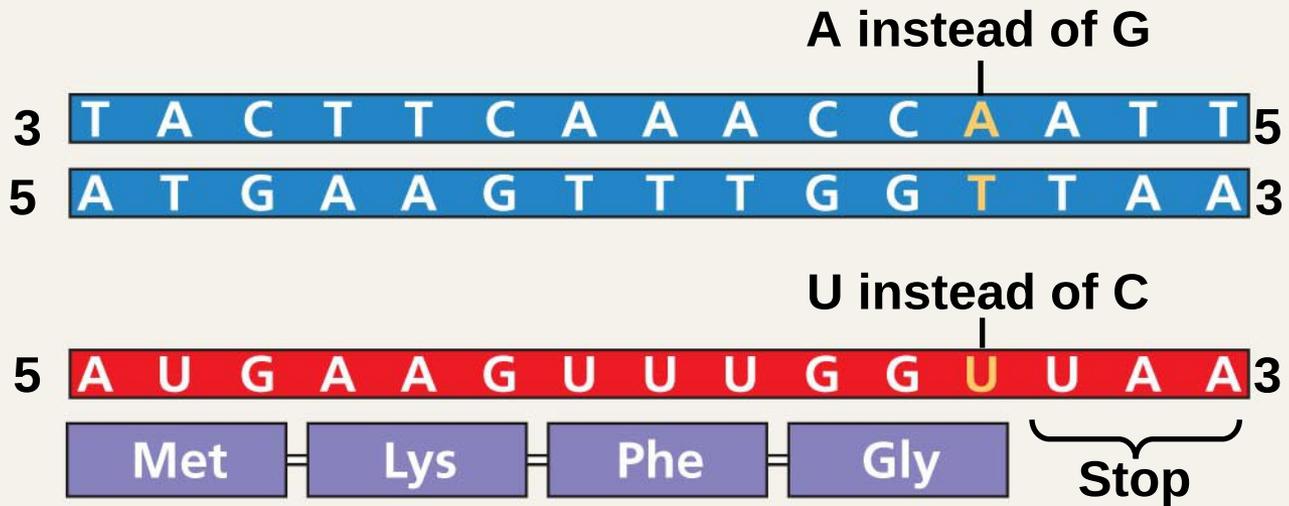
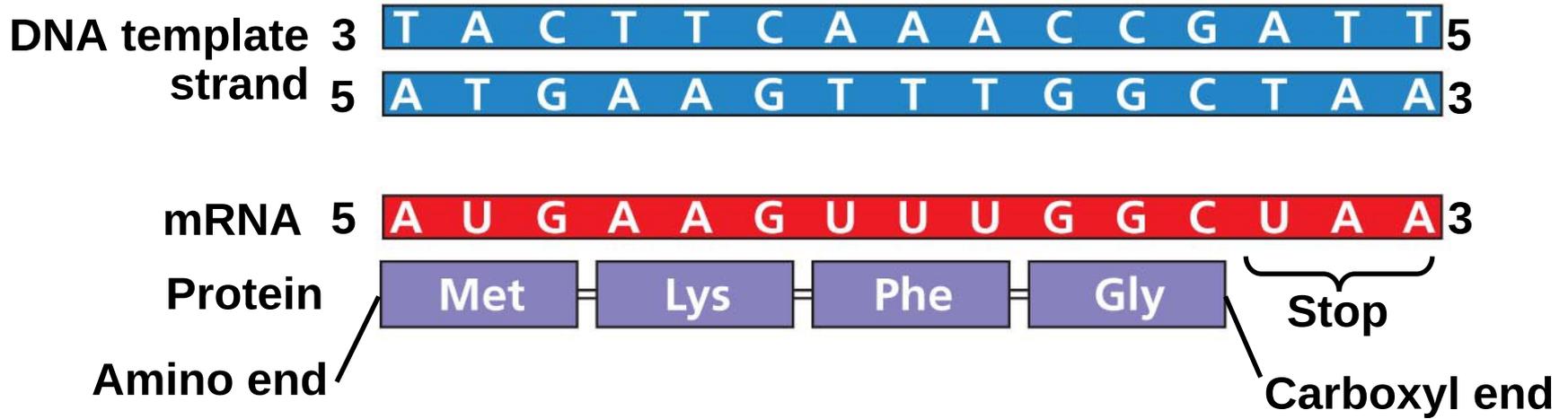
- Substitutie
- Insertie of deletie (indels)



(a) Base-pair substitution

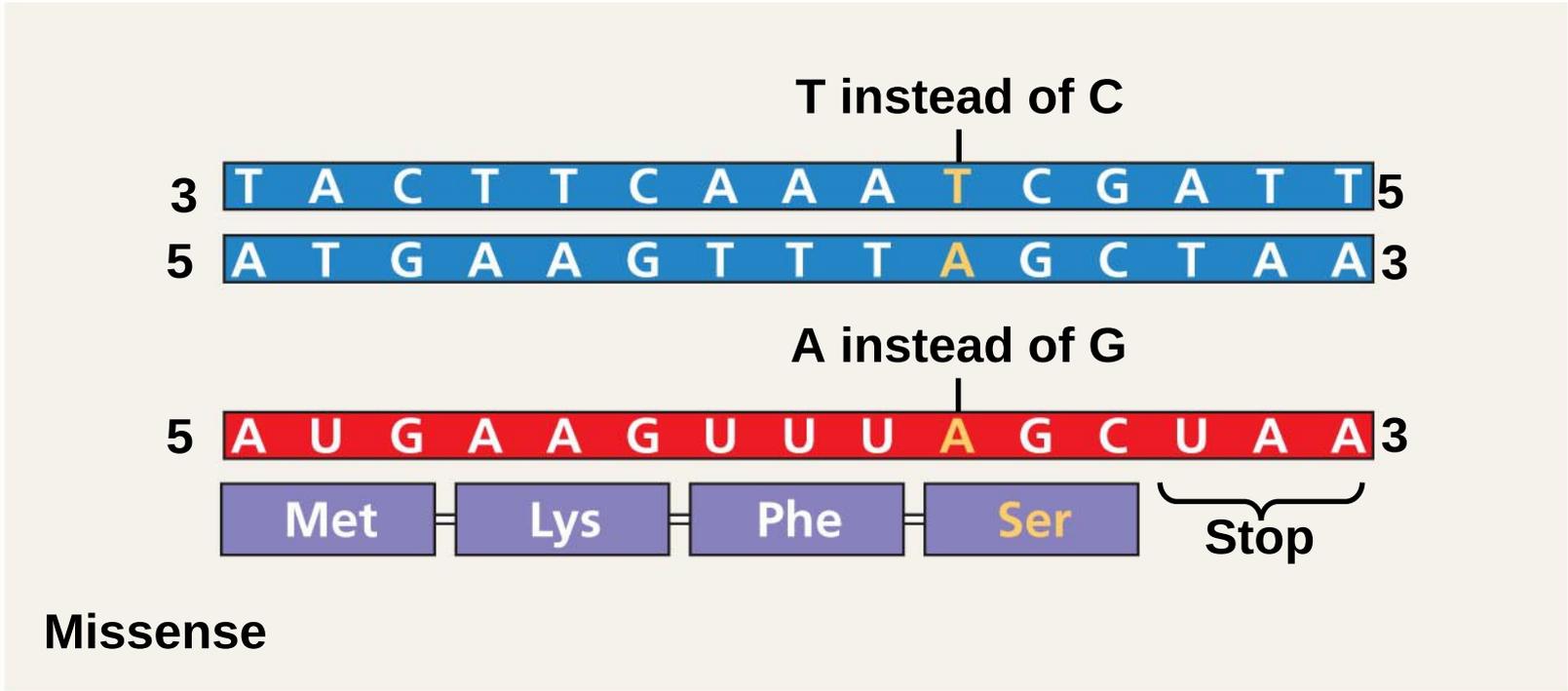
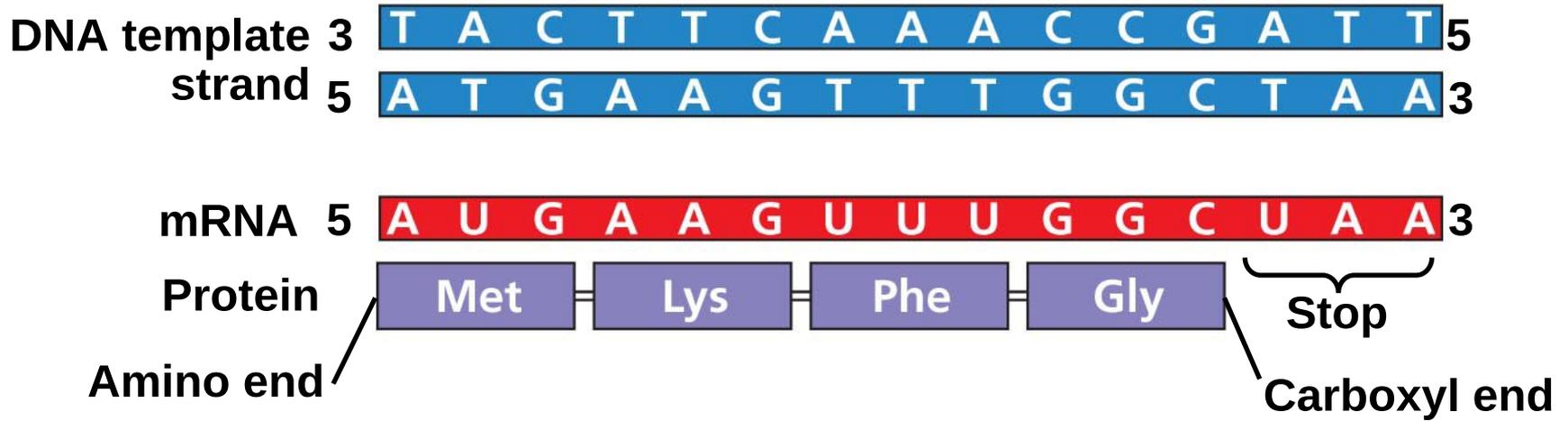
(b) Base-pair insertion or deletion

Wild type

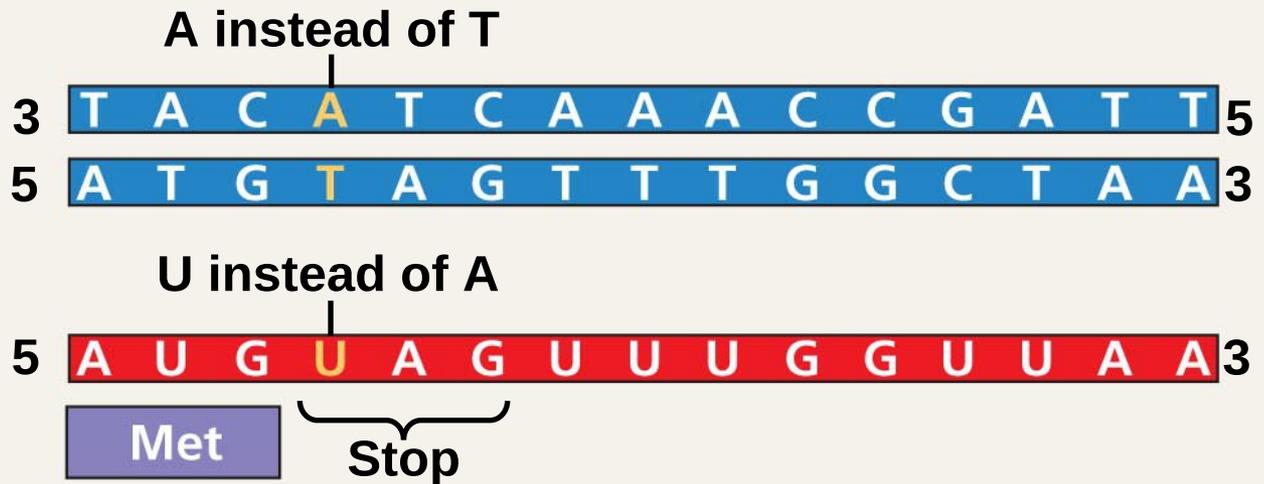
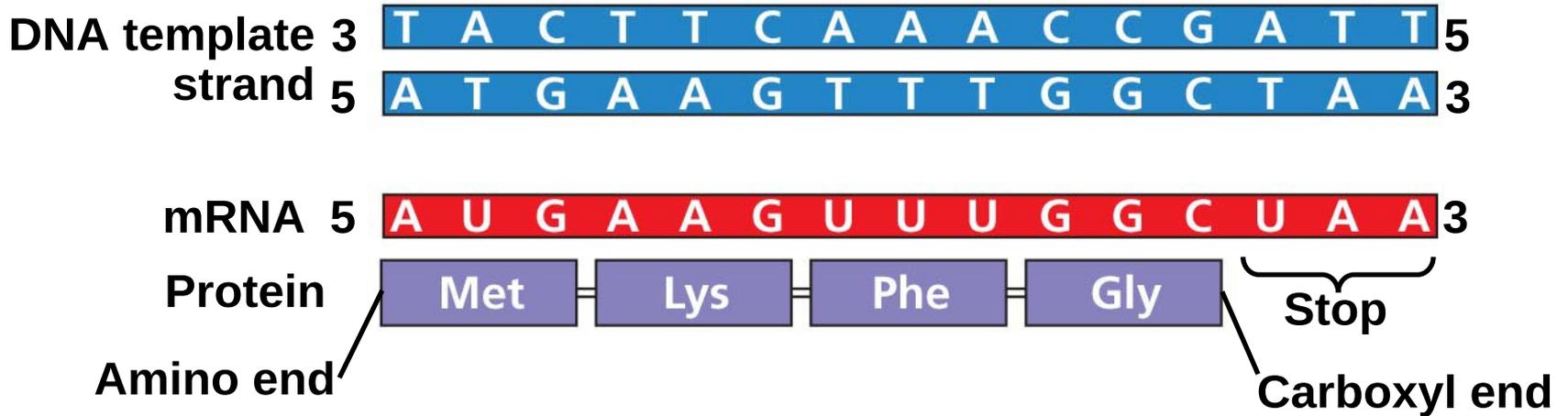


Silent (no effect on amino acid sequence)

Wild type

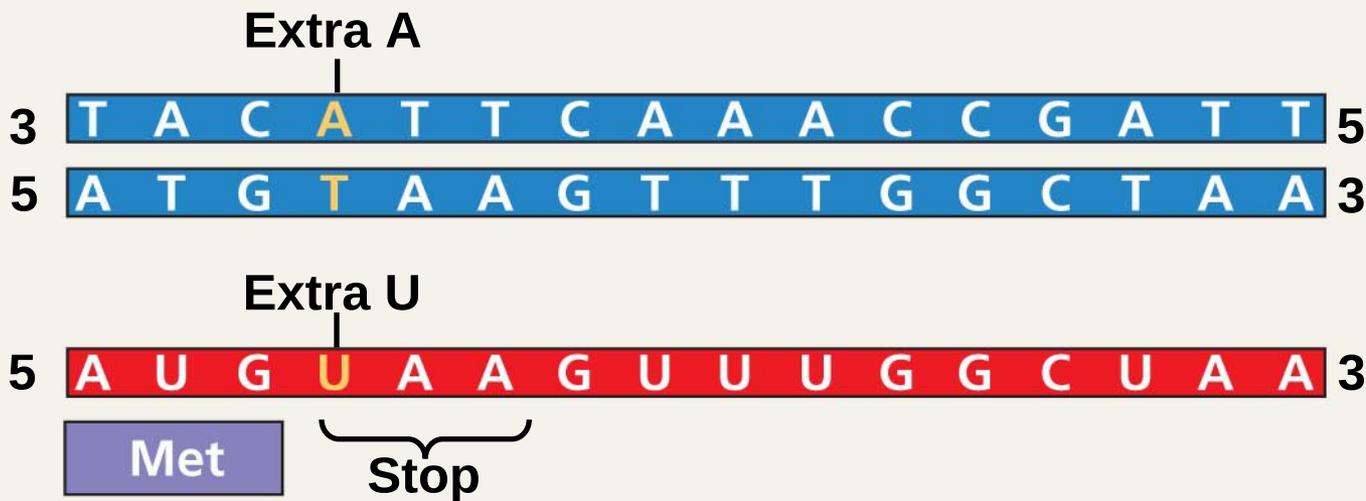
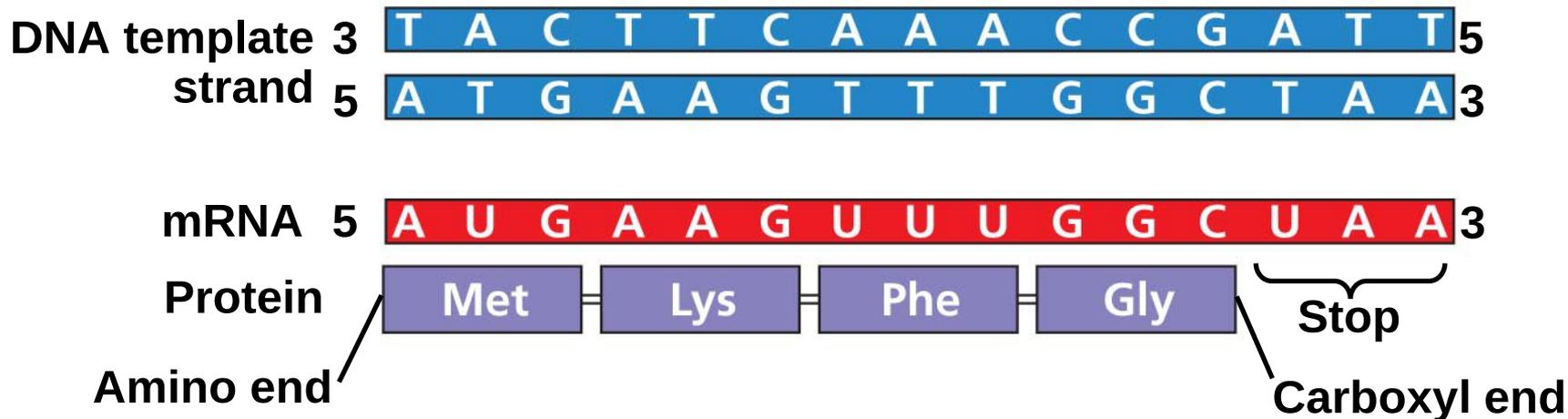


Wild type



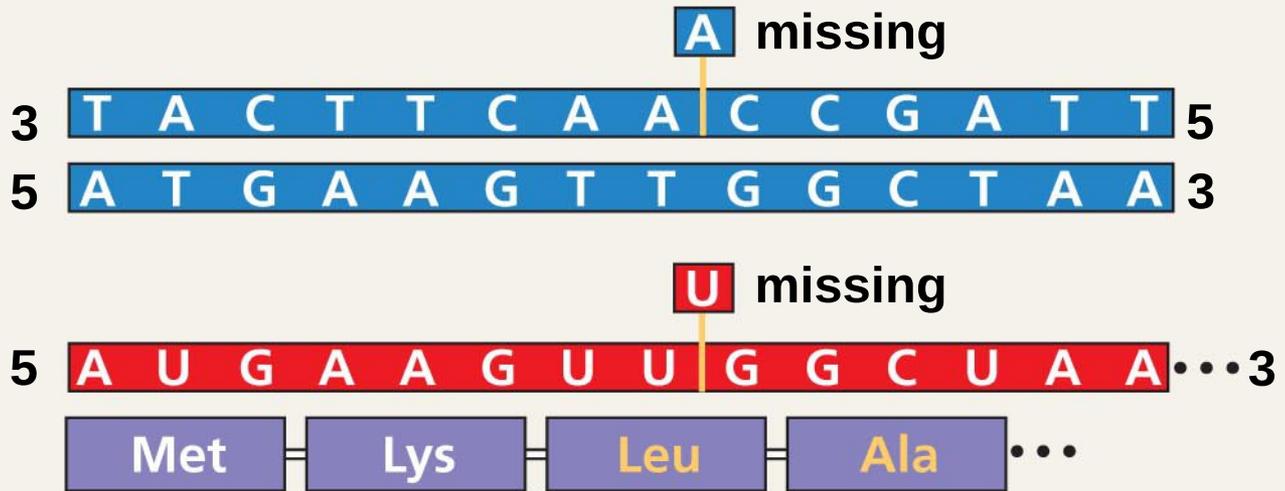
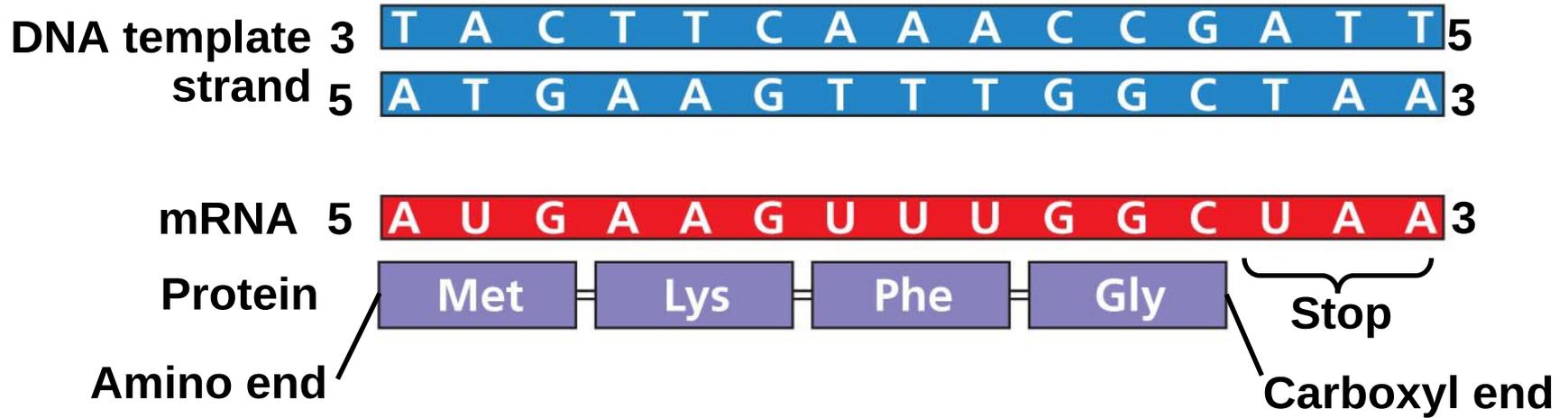
Nonsense

Wild type



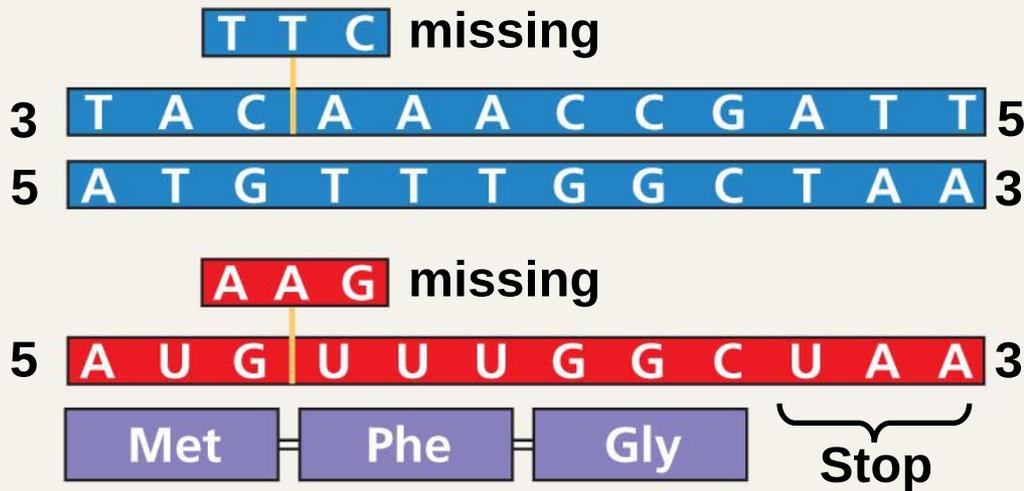
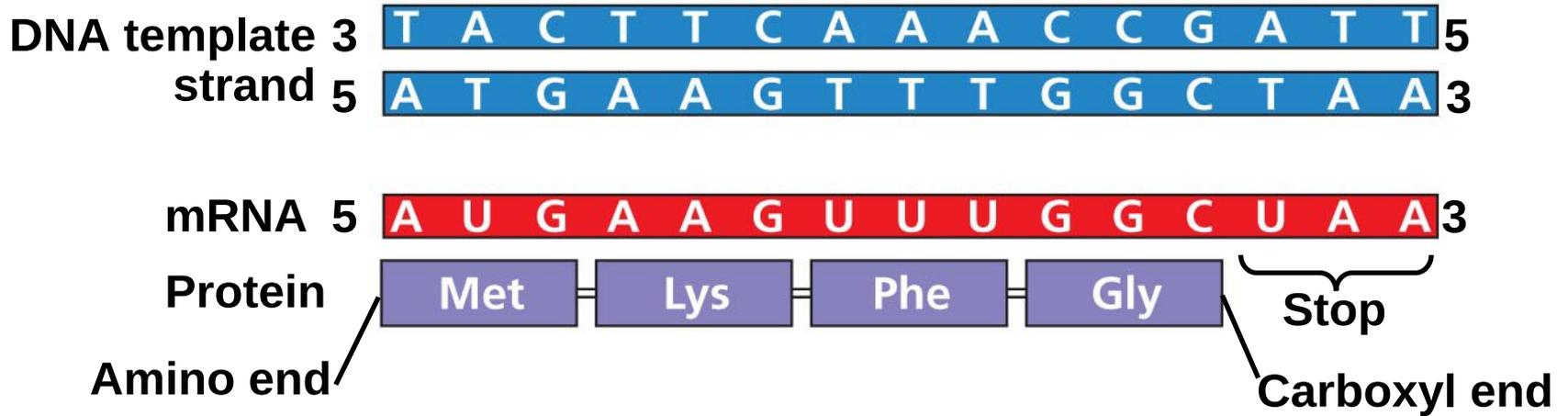
Frameshift causing immediate nonsense (1 base-pair insertion)

Wild type



Frameshift causing extensive missense (1 base-pair deletion)

Wild type



No frameshift, but one amino acid missing (3 base-pair deletion)

Substituties

Substituties leiden tot

- Silent mutation: geen effect op het aminozuur
- Missense mutation: het polypeptide bevat een ander aminozuur
- Nonsense mutation: het polypeptide bevat een stopcodon op de verkeerde plaats

Indels

Een deletie of insertie van een nucleotide leidt tot een frameshift
Dit heeft meestal desastreuze gevolgen voor het proteïn

Vraag

Wat zijn de meest invloedrijke mutaties?

Wat zijn mogelijke oorzaken van deze mutaties?

Samengevat

Middels transcriptie wordt mRNA gevormd

Het mRNA bevat codons bestaande uit steeds 3 nucleotiden

Ieder codon codeert voor een aminozuur

Alle aminozuren samen vormen polypeptiden

Fig. 17-25

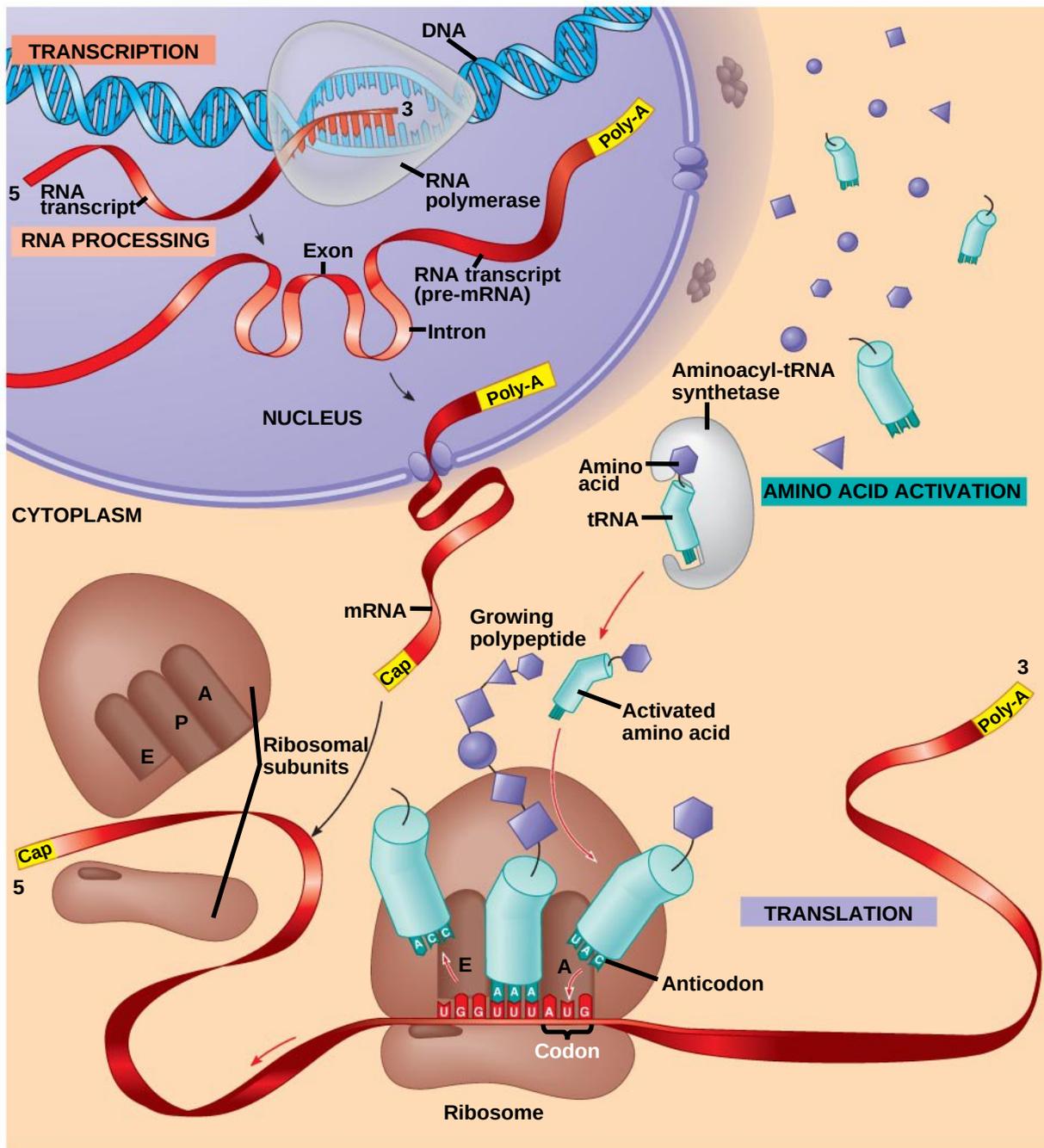
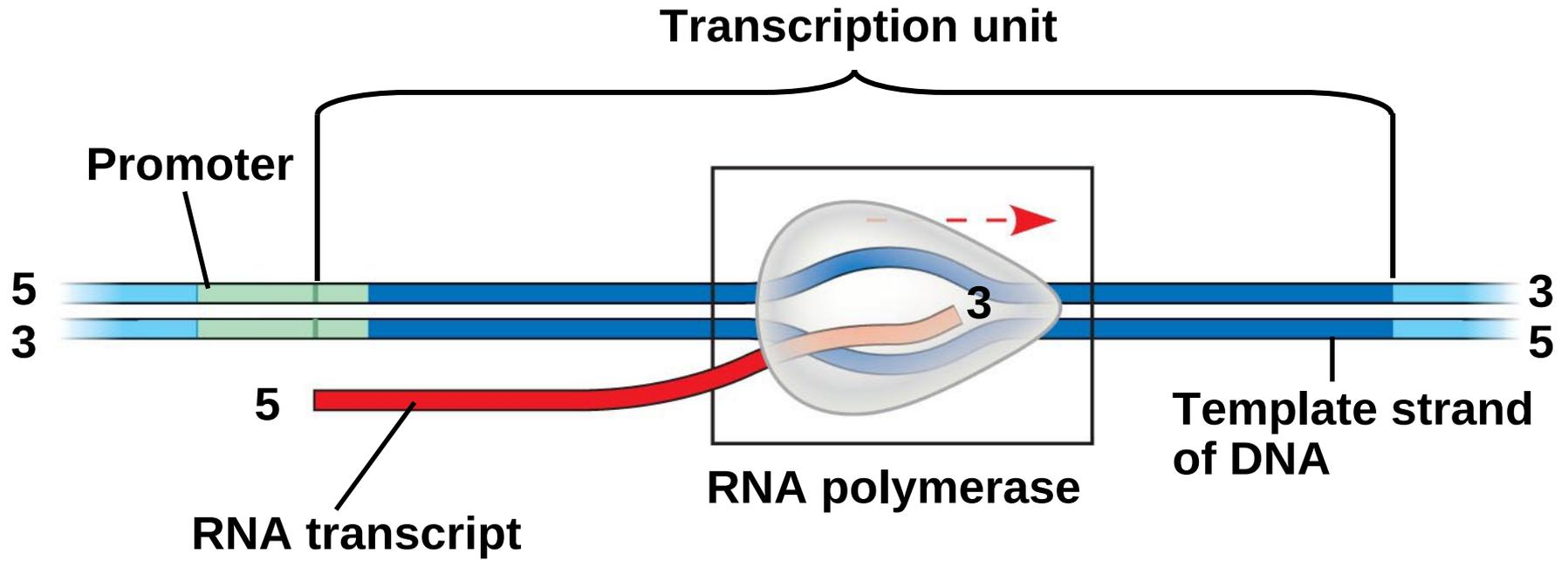
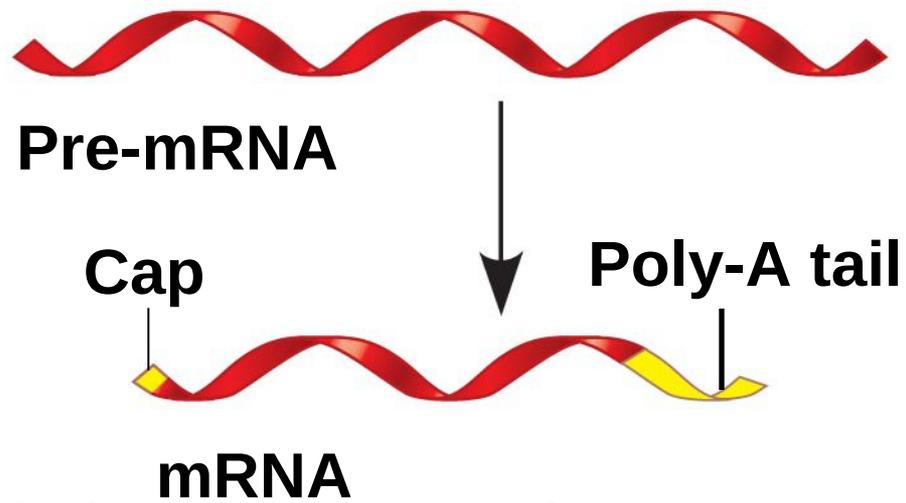


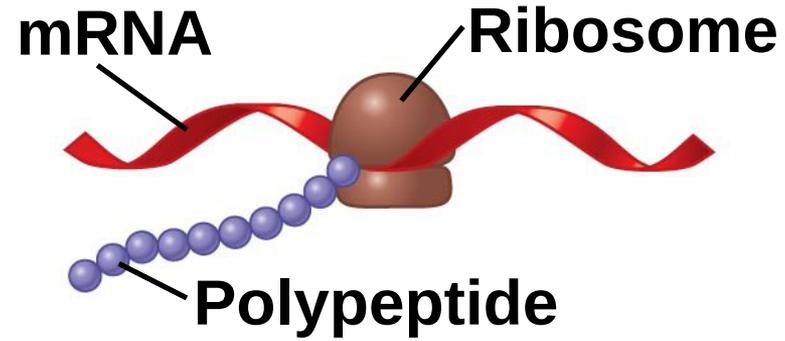
Fig. 17-UN1



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